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Wood et al.

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(54) **WELLBORE TONG**

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E21B 19/16 (2006.01)

(52) **U.S. Cl.**
CPC ***E21B 19/161*** (2013.01)

(58) **Field of Classification Search**
CPC E21B 19/161; B25B 13/50
See application file for complete search history.

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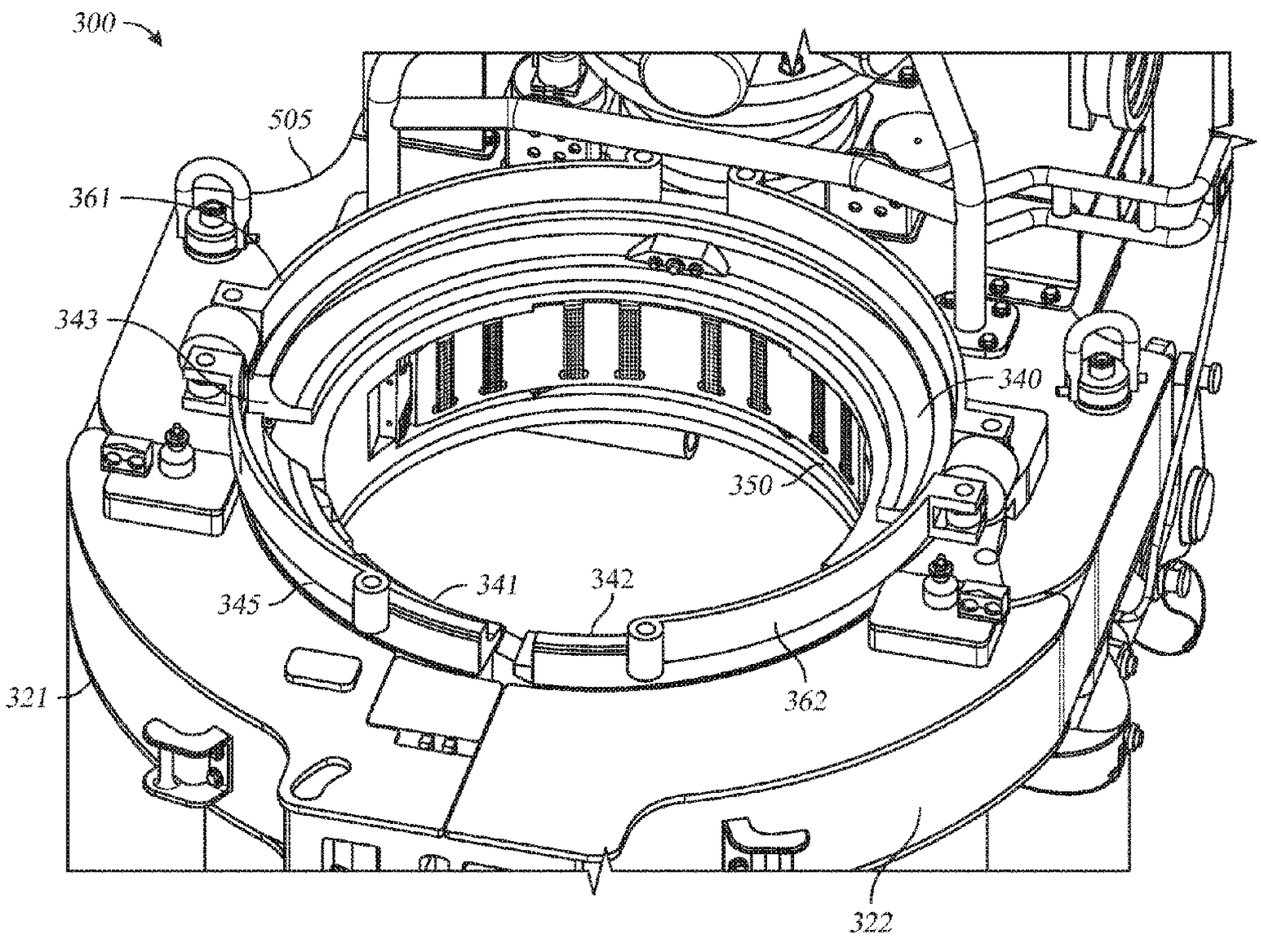
(57) **ABSTRACT**

A tong for use at a wellbore includes a tong body; at least one door pivotally coupled to the tong body and movable between an open position and a closed position; a carrier ring rotatable relative to the tong body; and a brake plate coupled to the carrier ring. The tong also includes a brake band configured to move with the at least one door between the open and closed positions, and a braking member for moving the brake band into contact with the brake plate to stop rotation of the carrier ring.

20 Claims, 21 Drawing Sheets



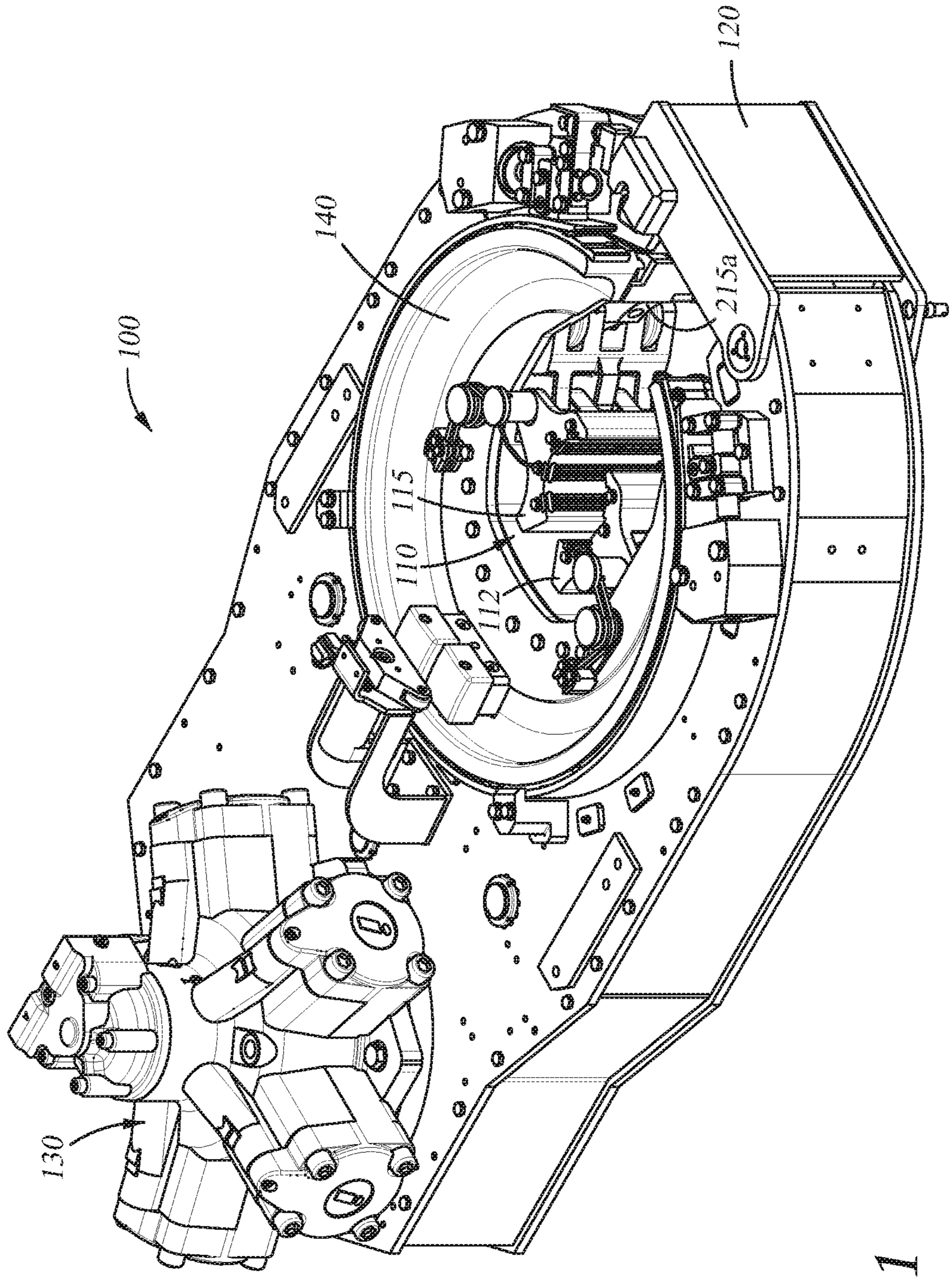


Fig. 1

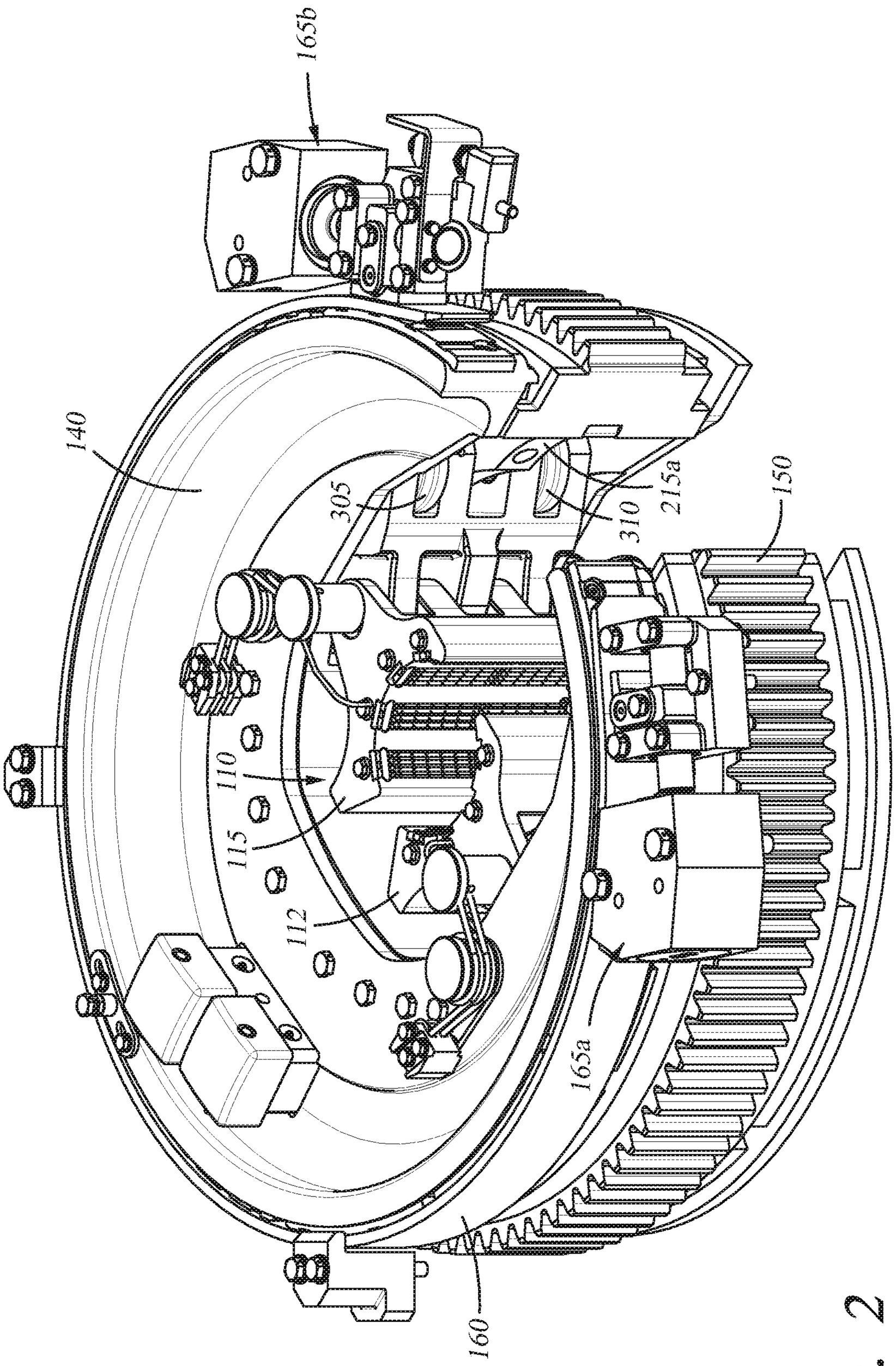


Fig. 2

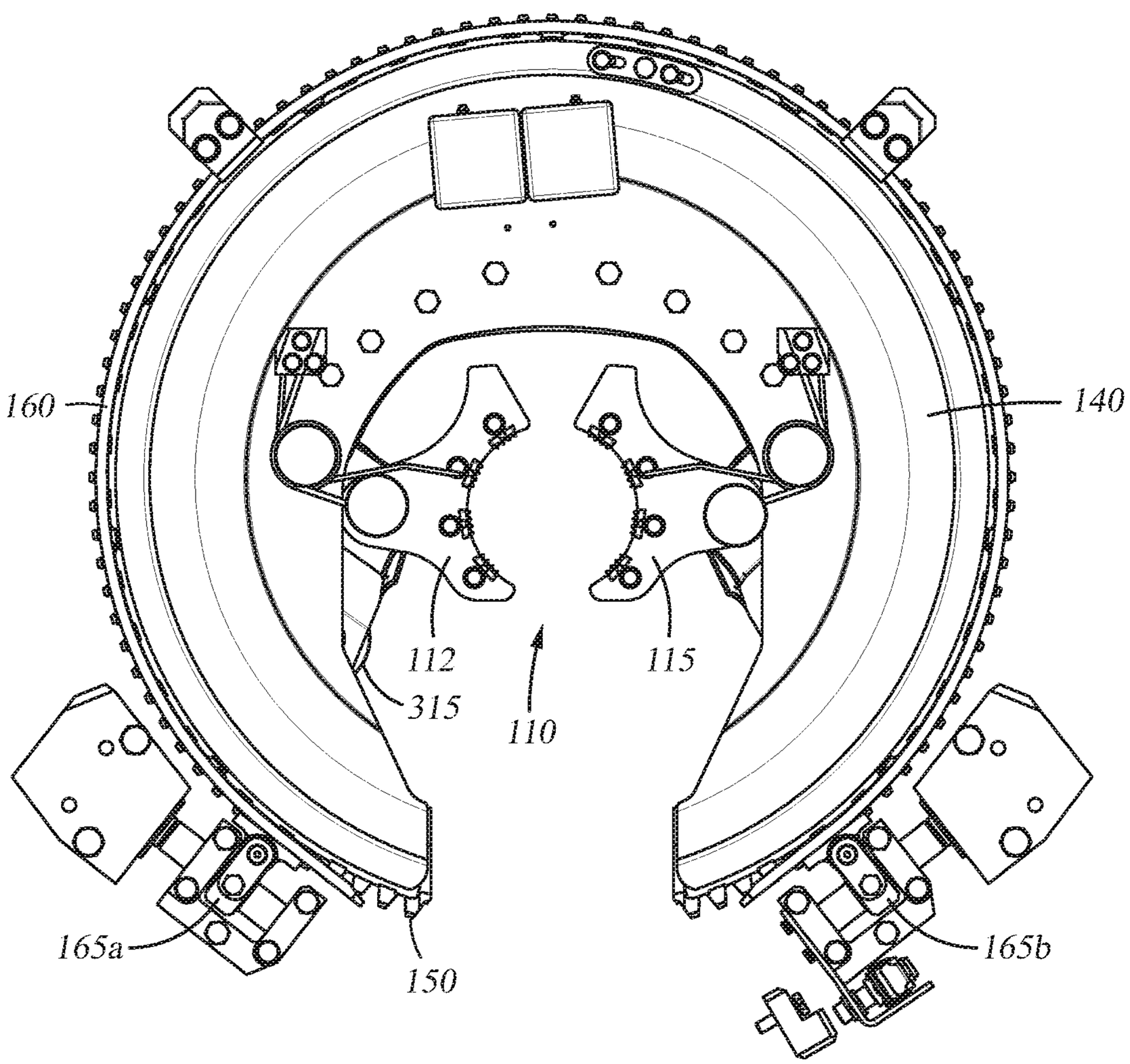


Fig. 3

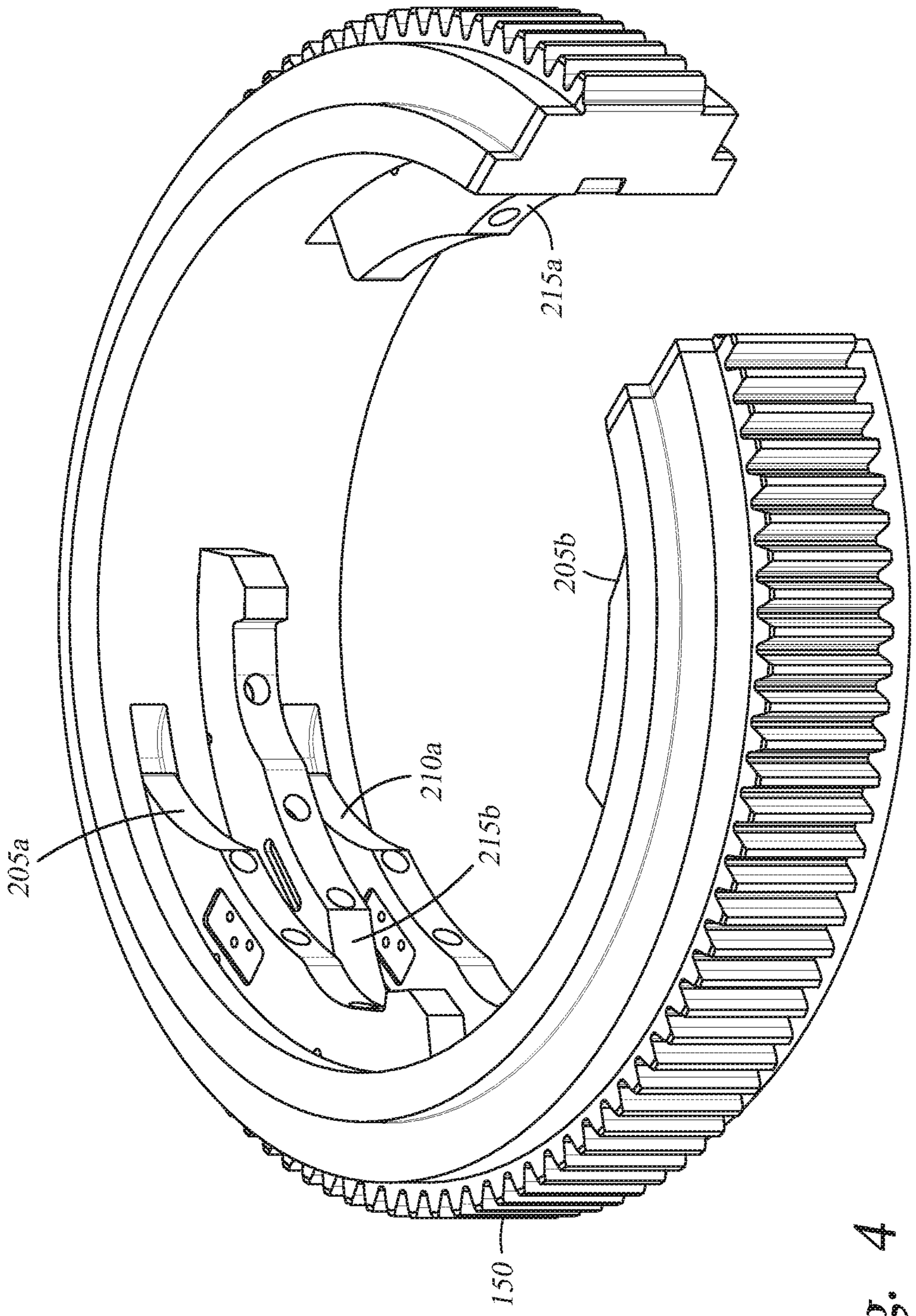
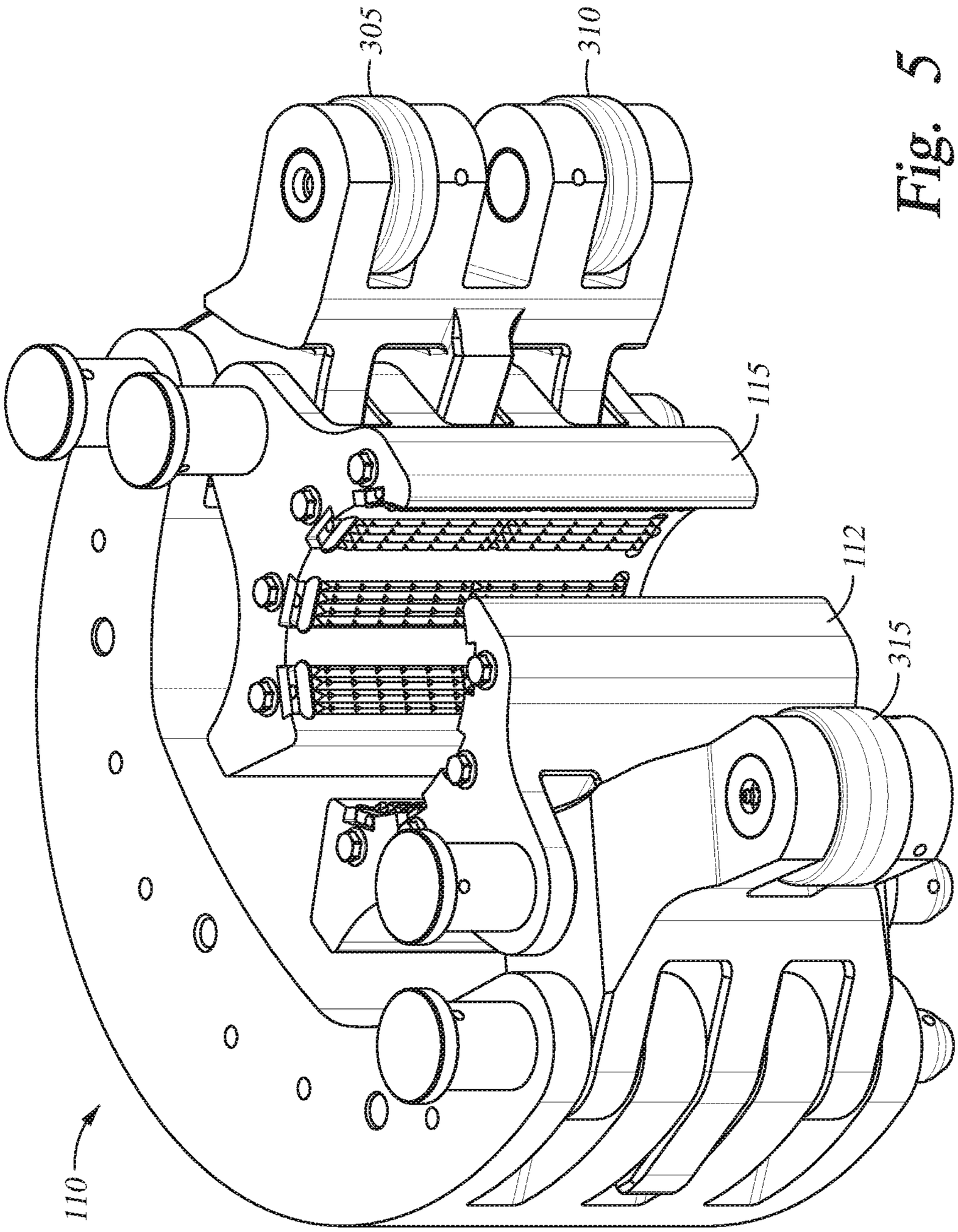


Fig. 4



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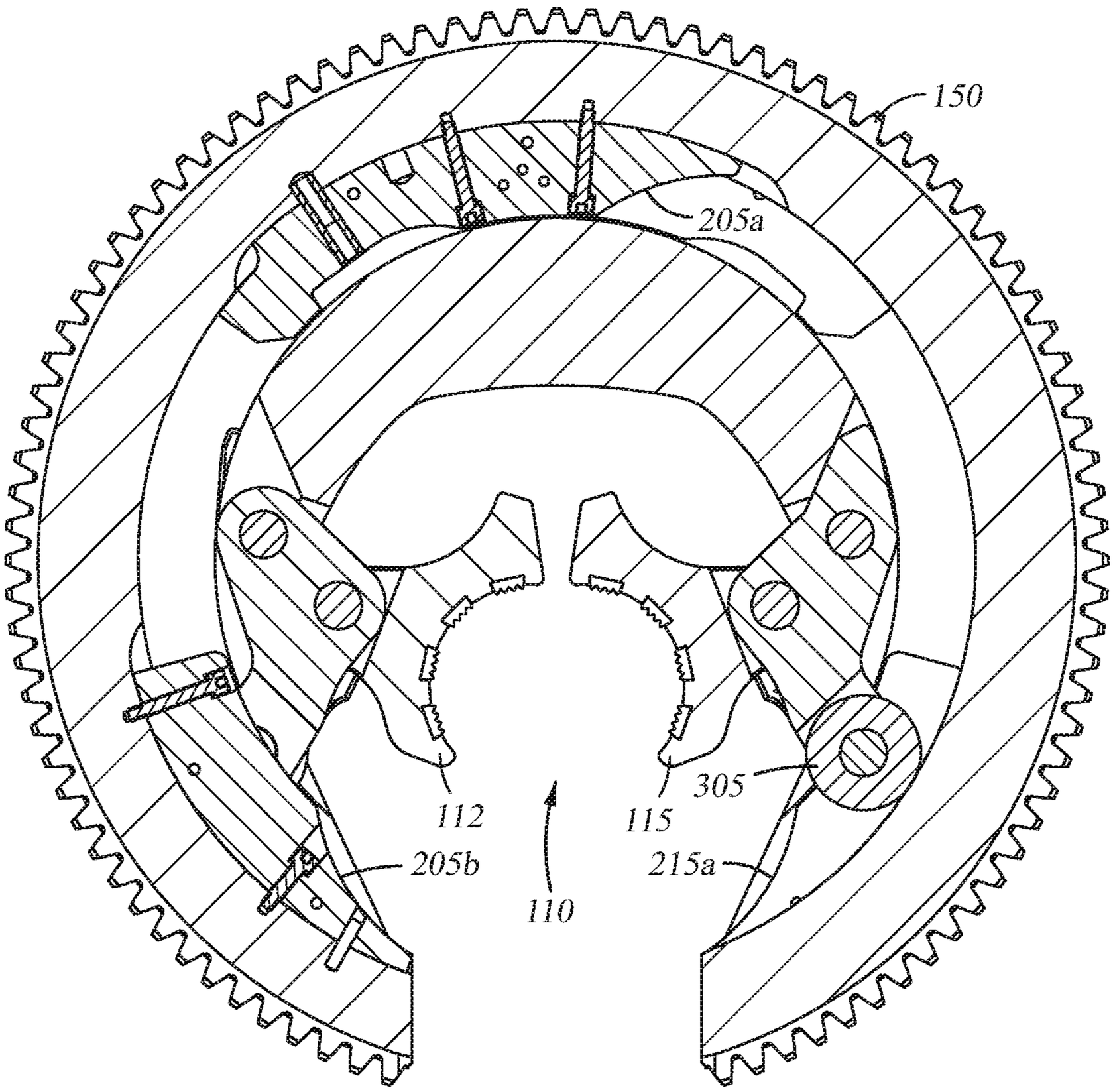


Fig. 6

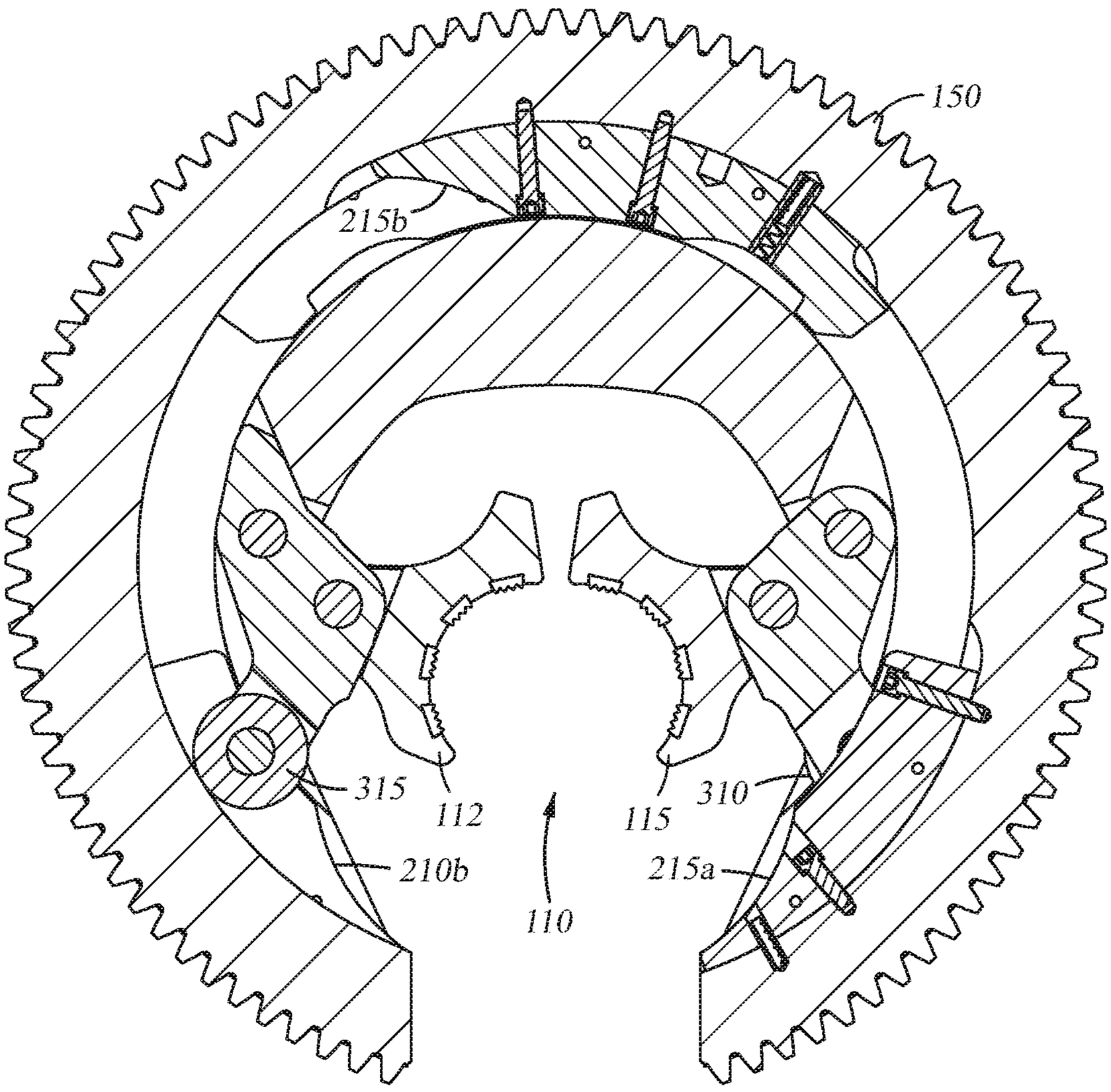


Fig. 7

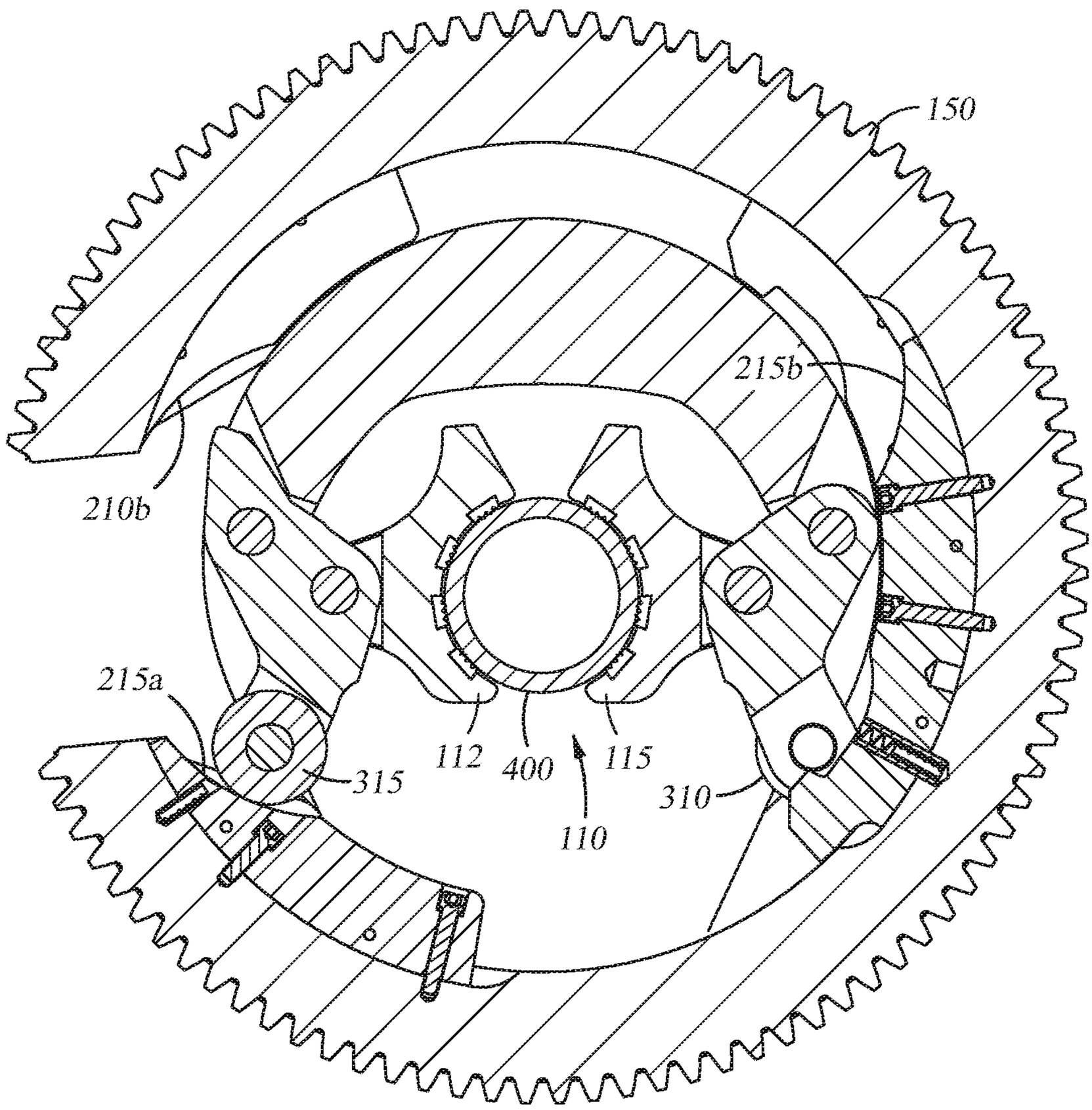


Fig. 8

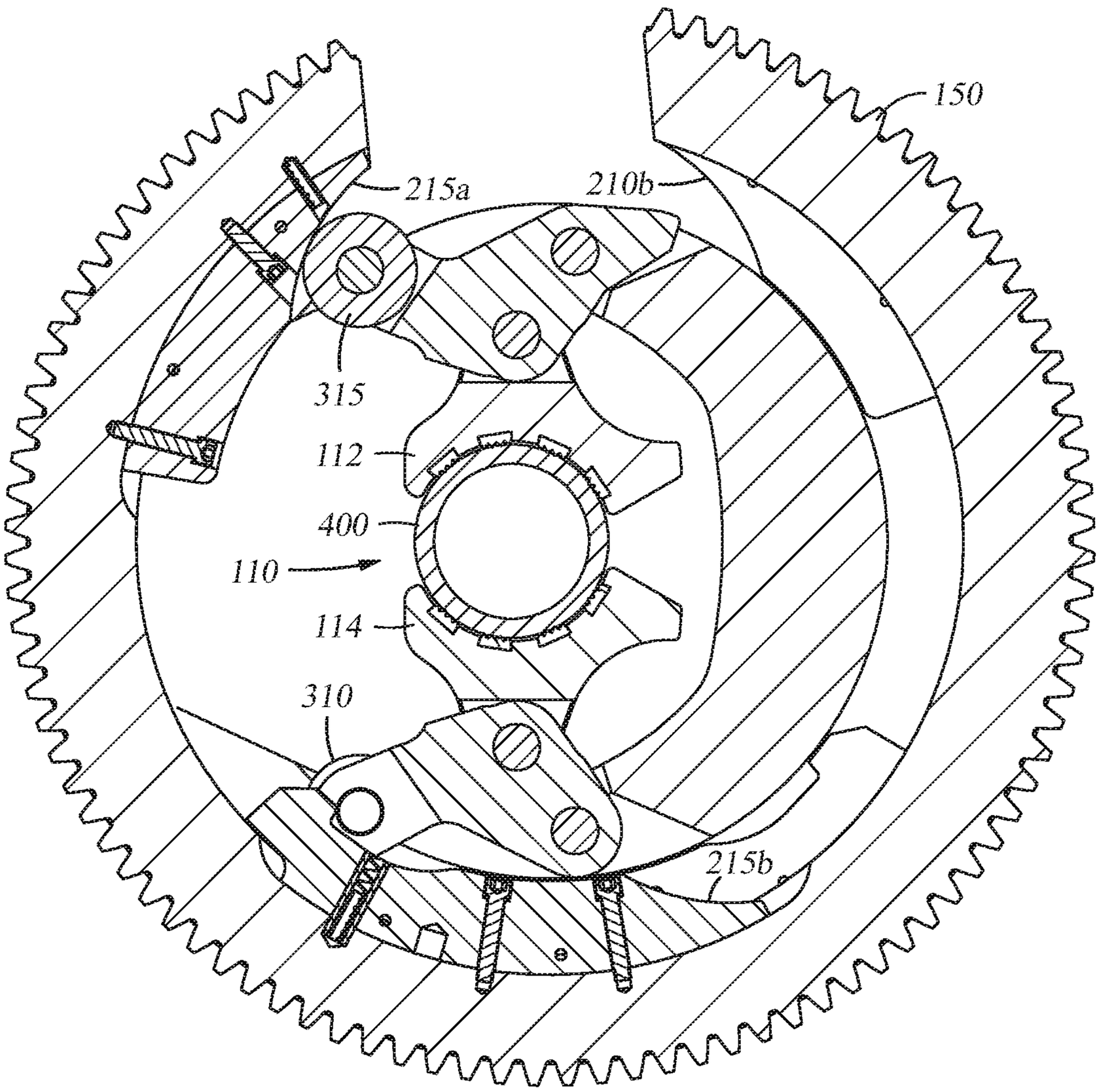


Fig. 9

Fig. 10

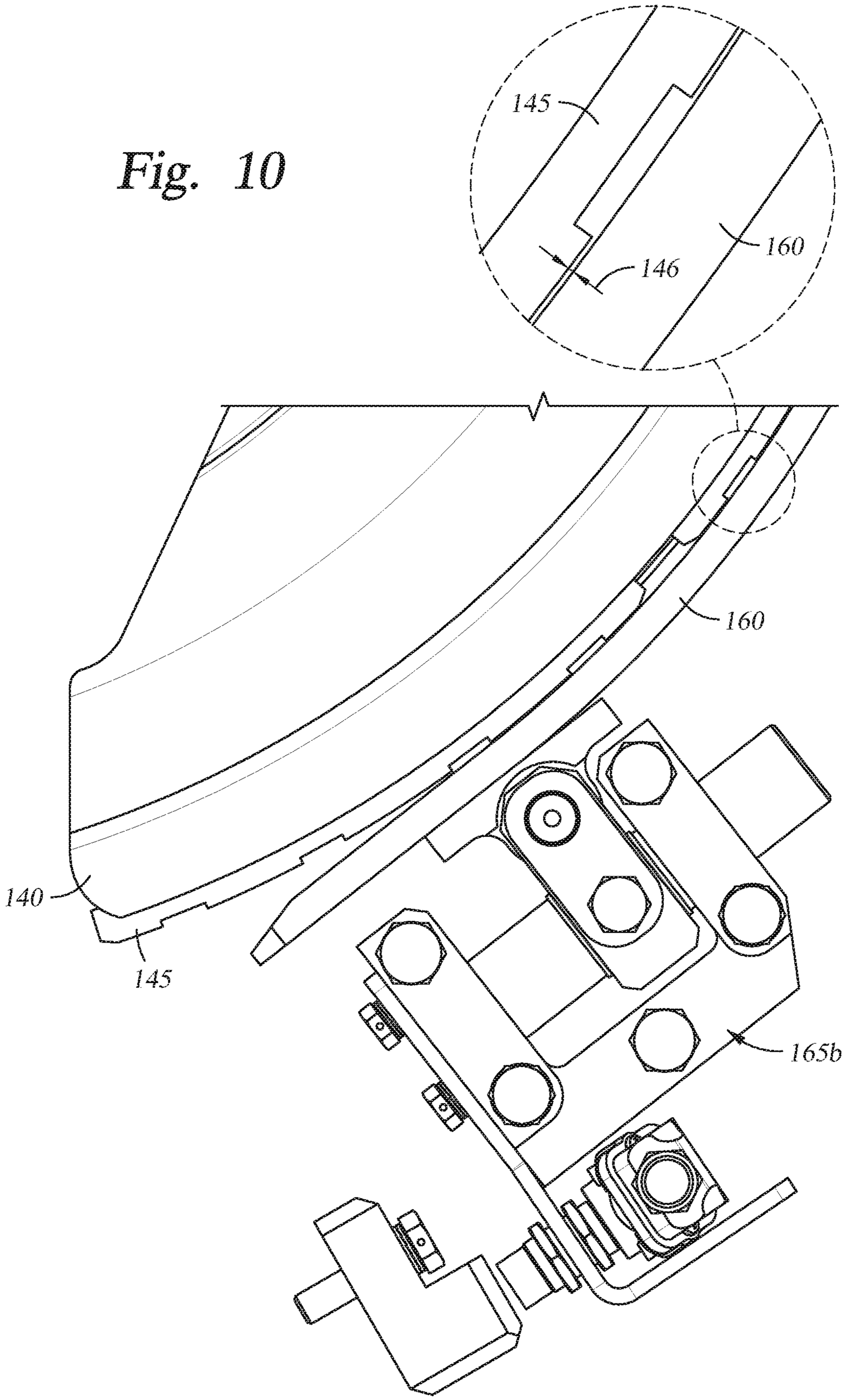
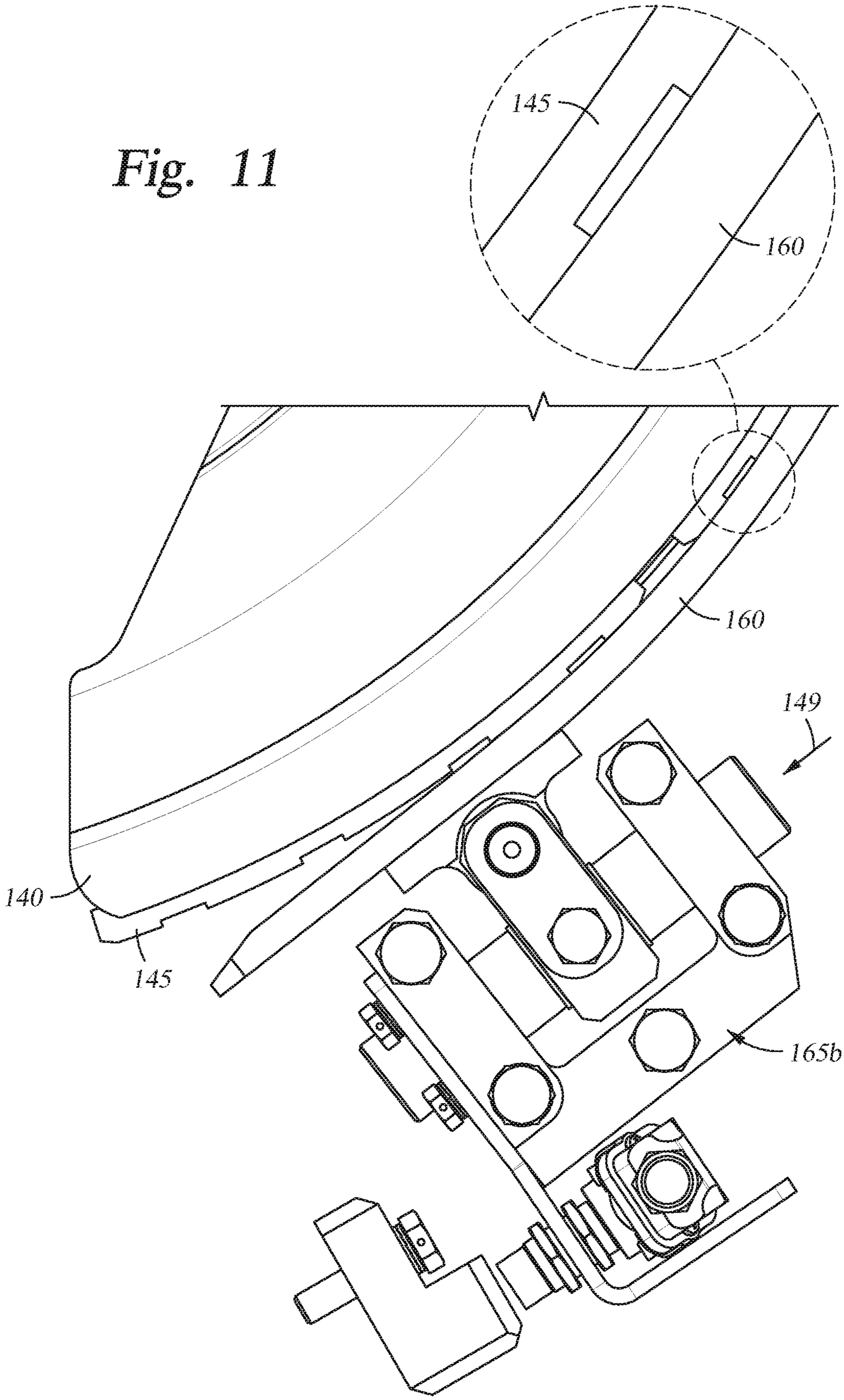


Fig. 11



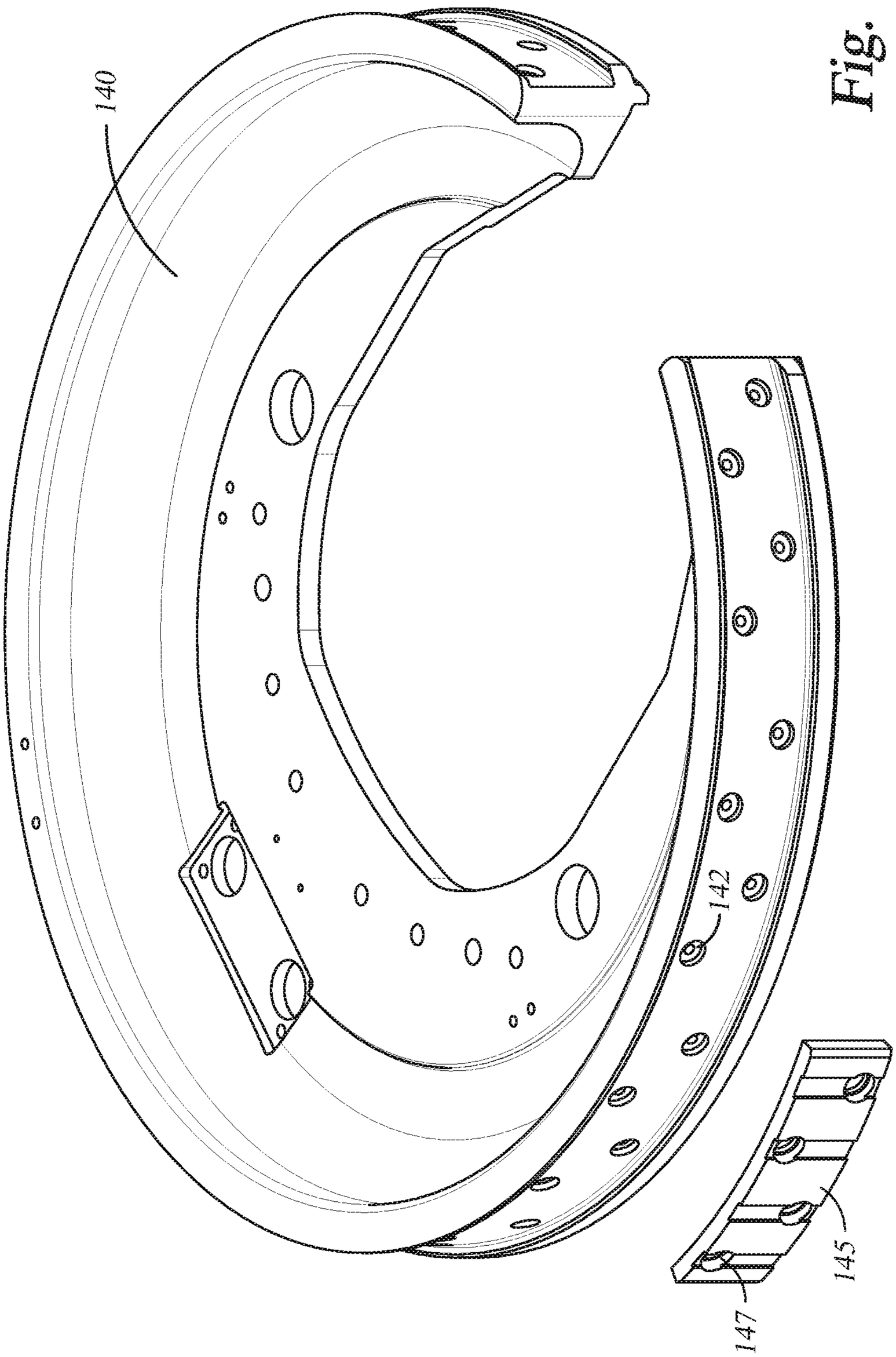


Fig. 12

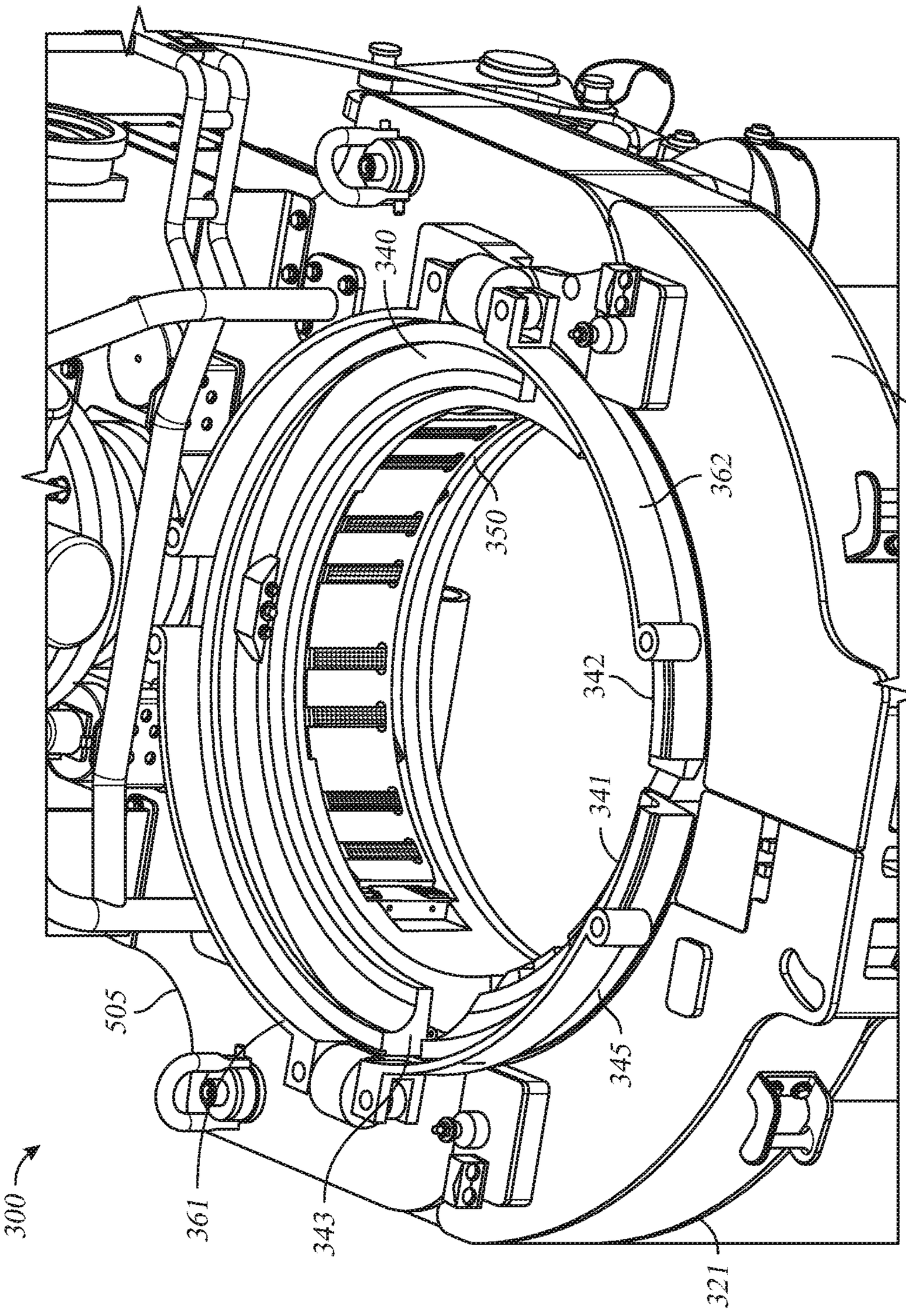


Fig. 13

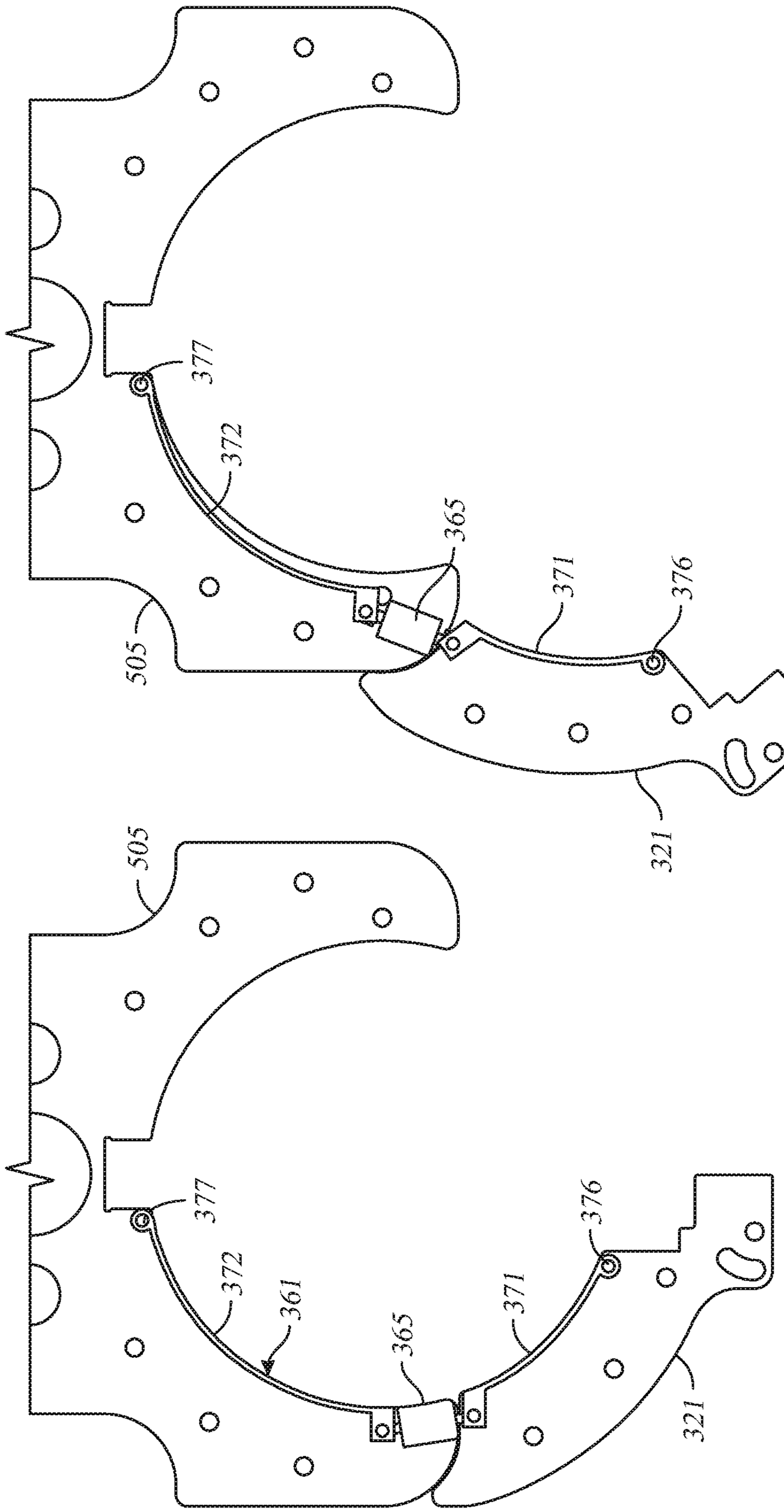


Fig. 15

Fig. 14

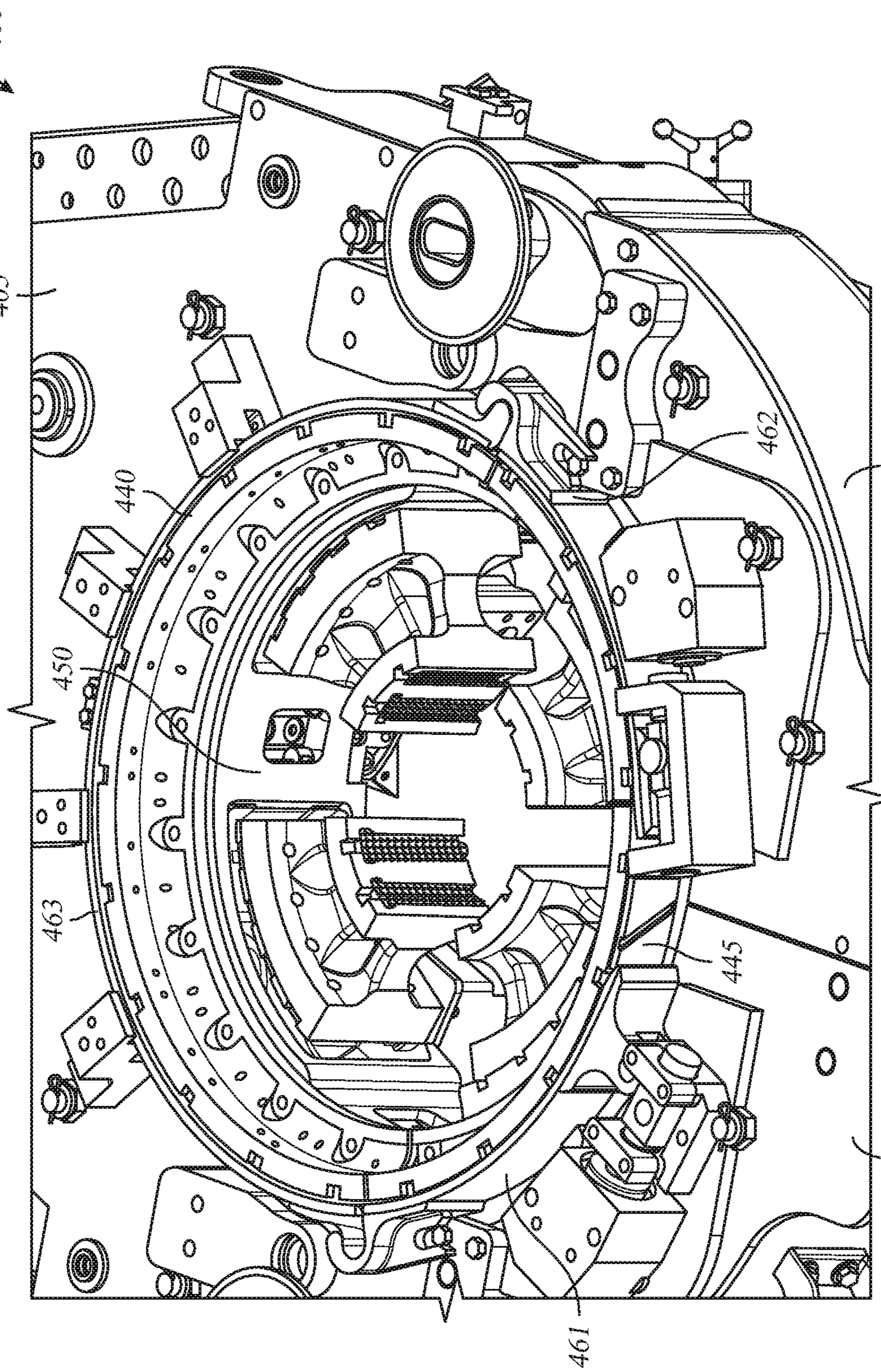


Fig. 16

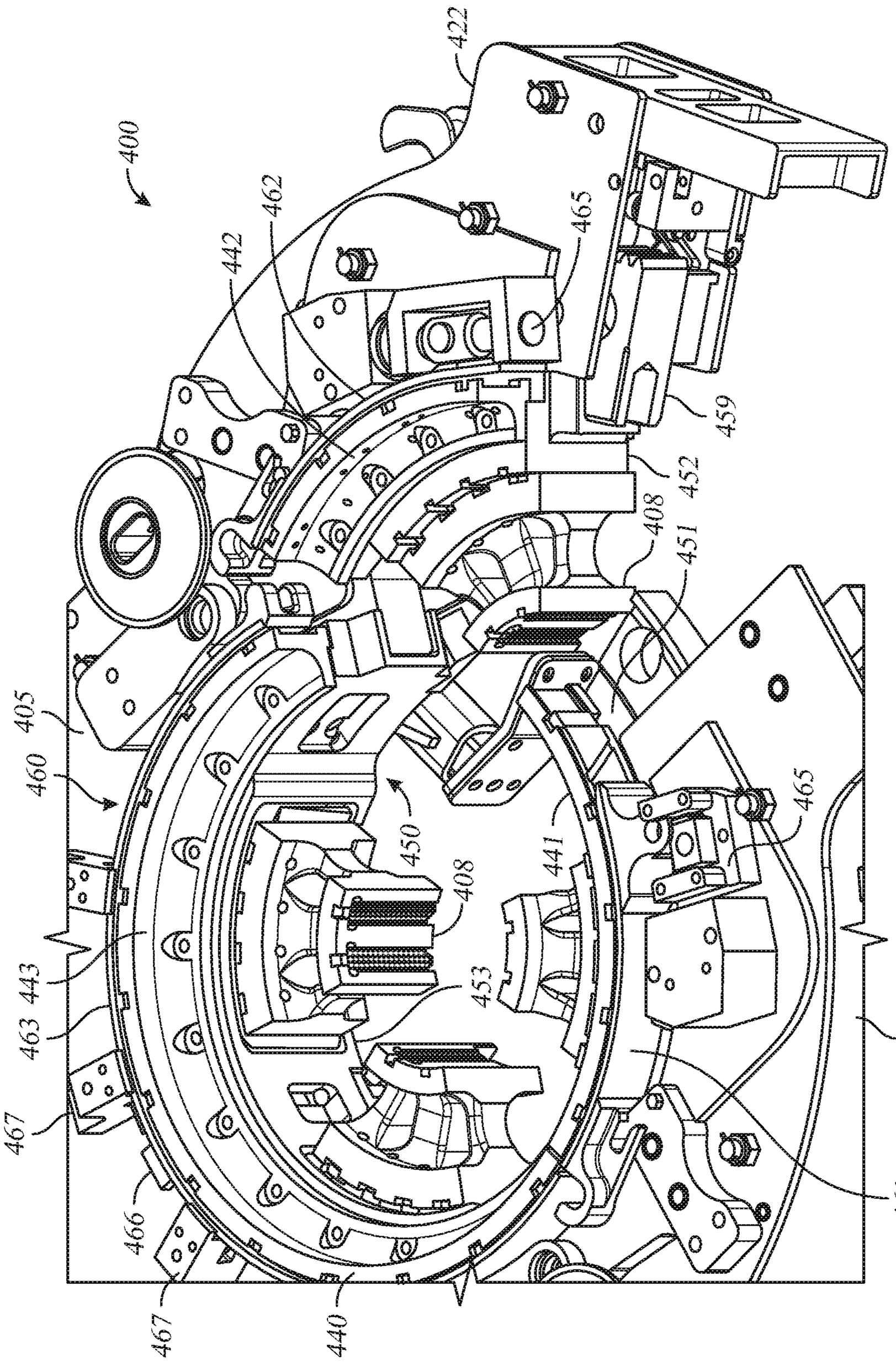

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Fig. 17

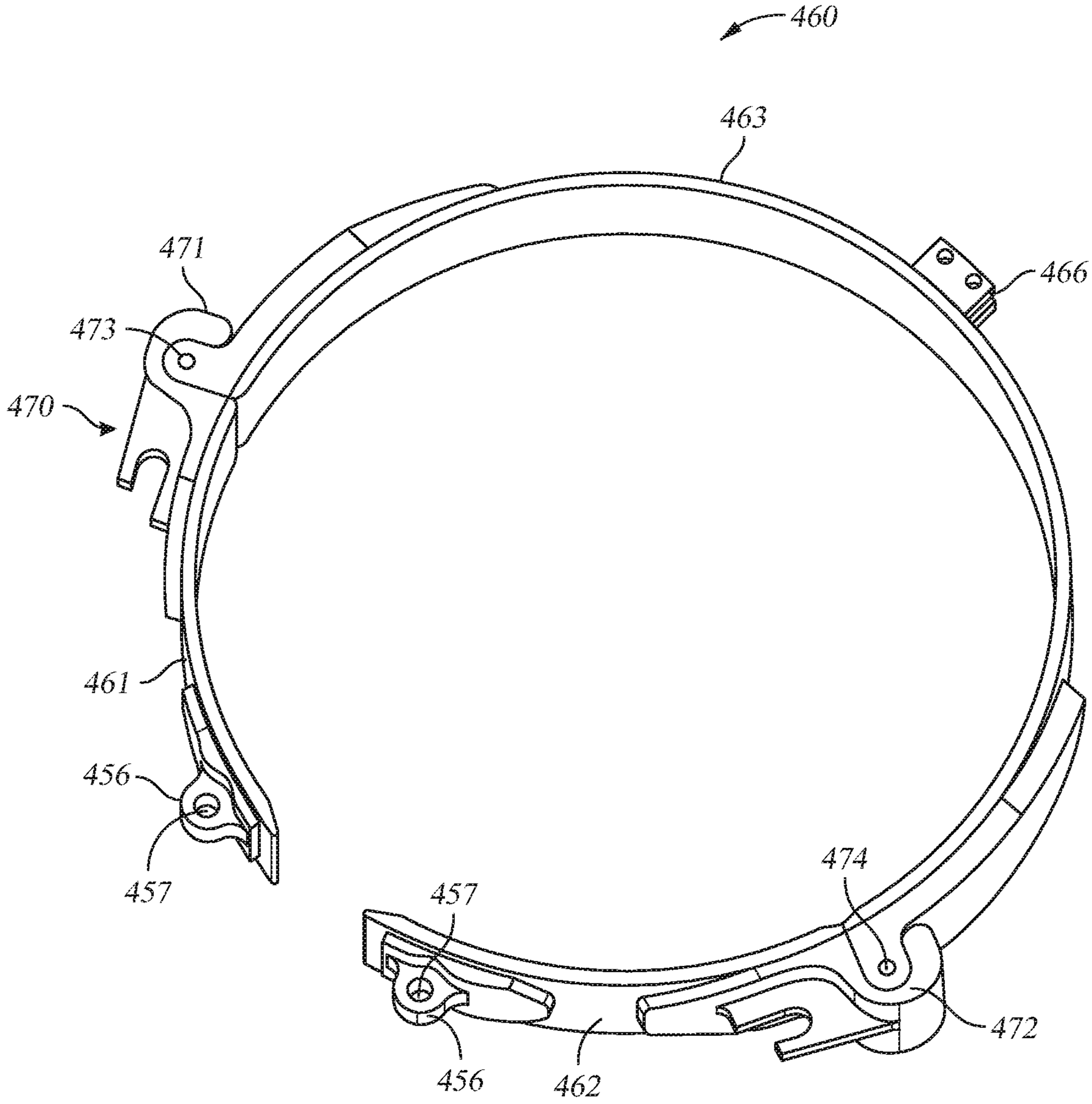

Fig. 18

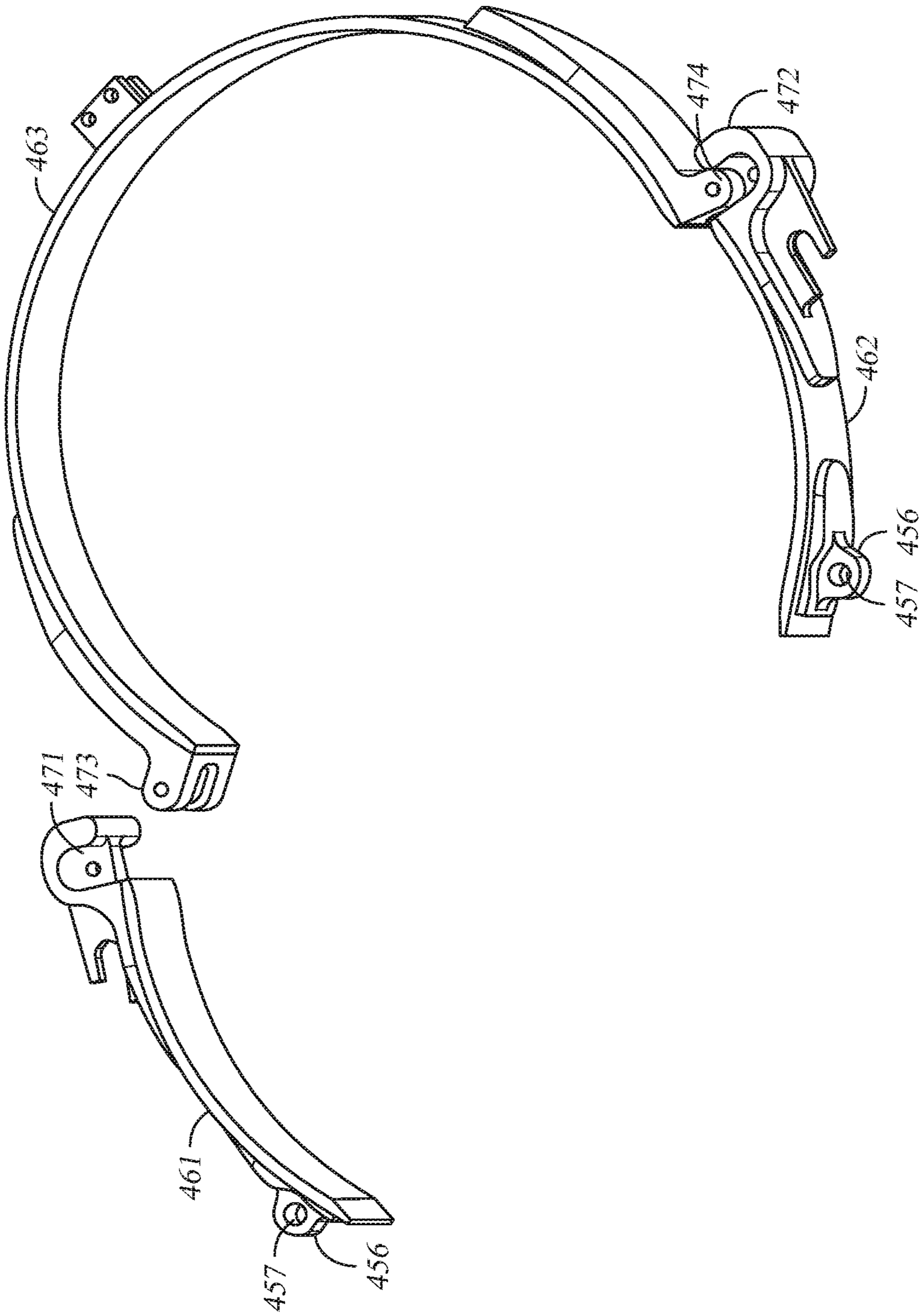

Fig. 19

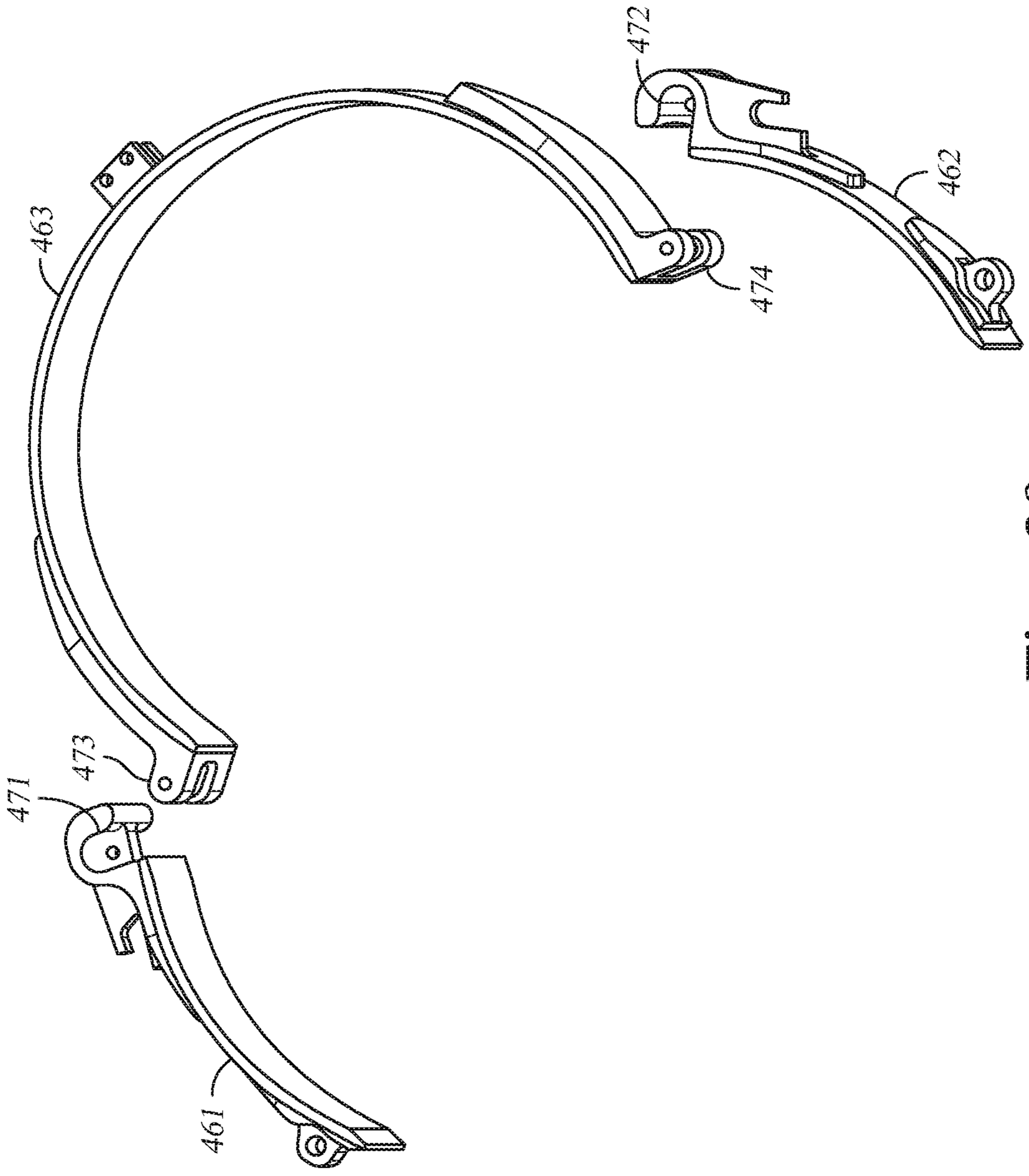

Fig. 20

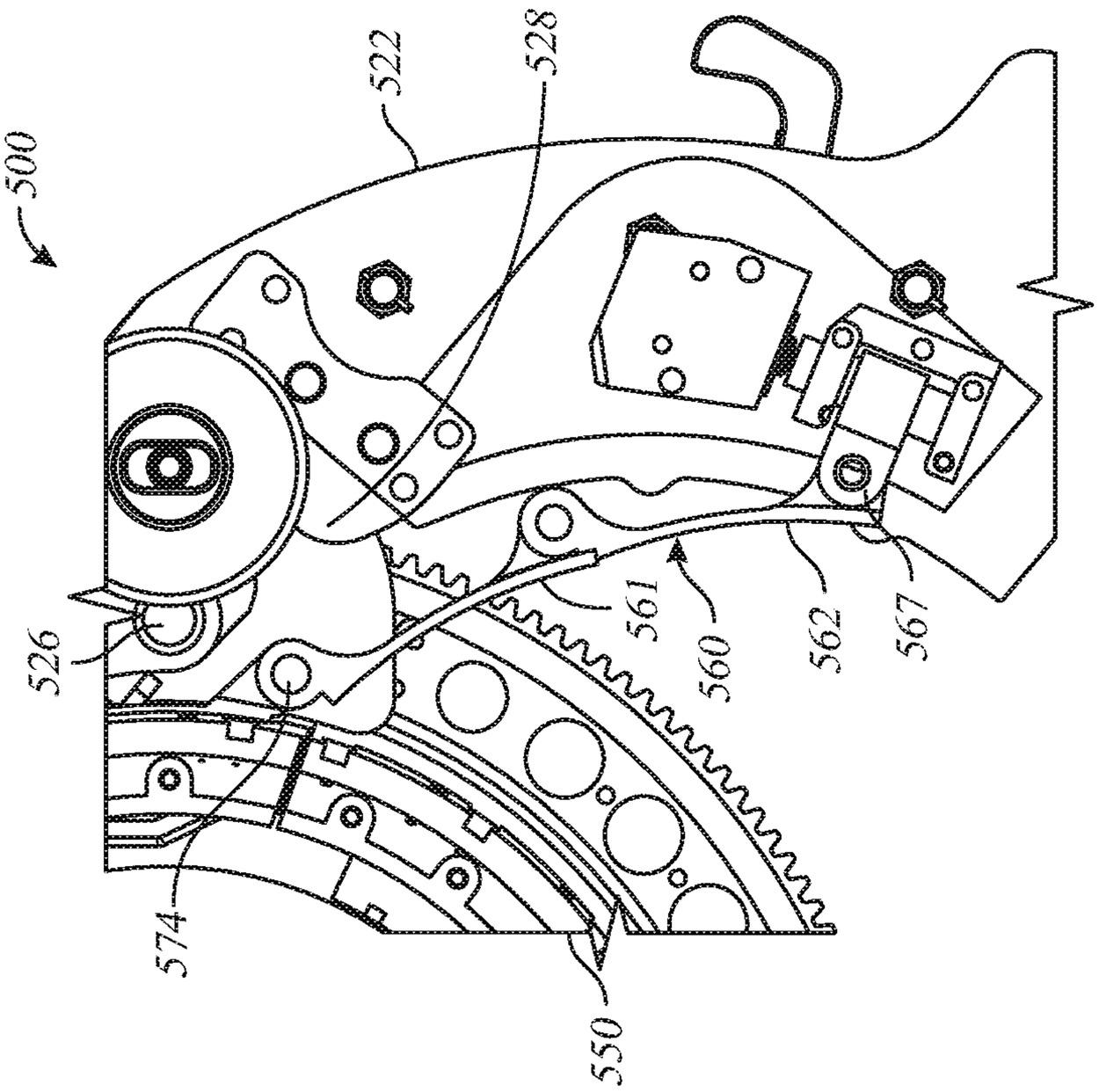
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Fig. 22

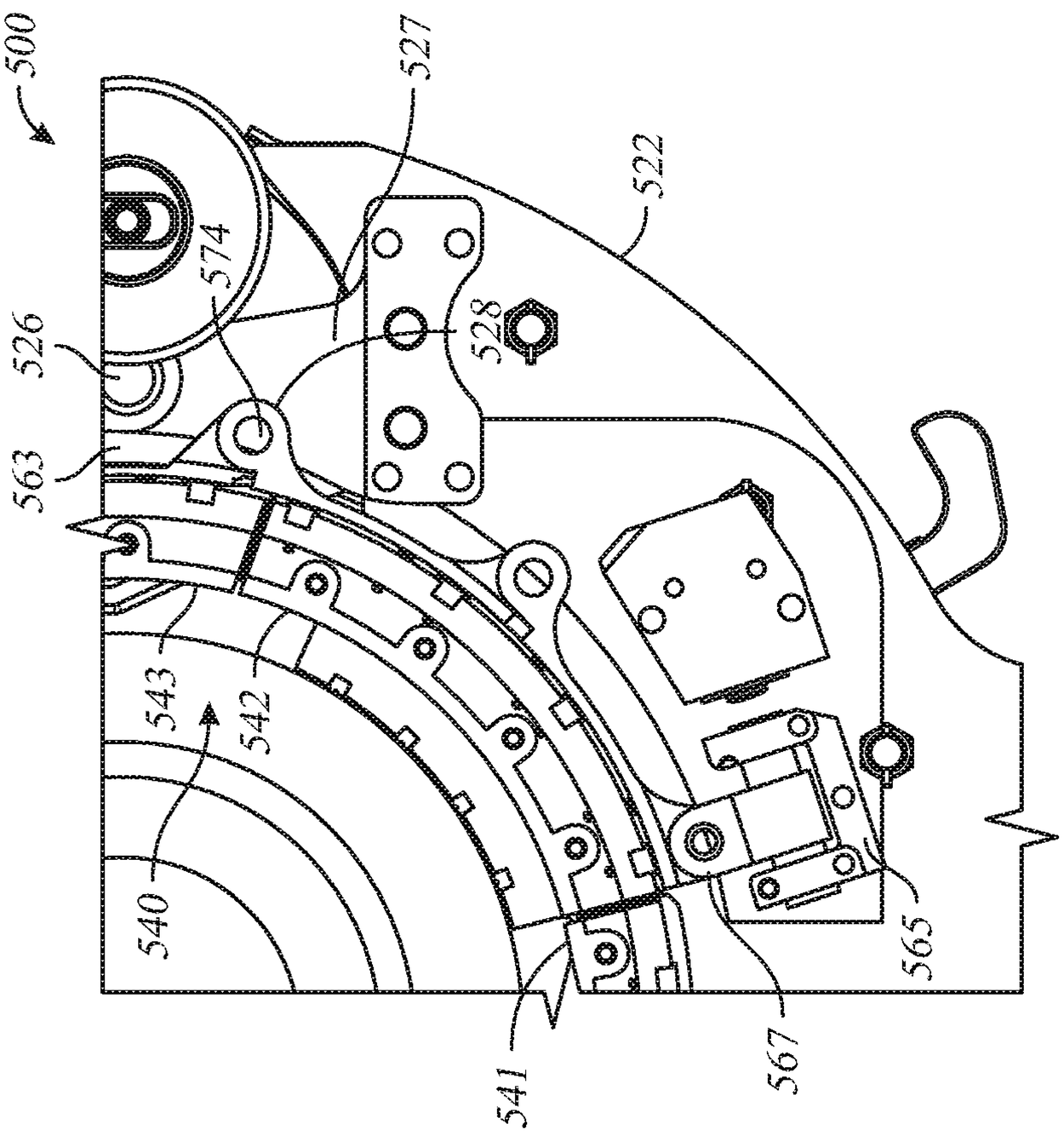
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Fig. 21

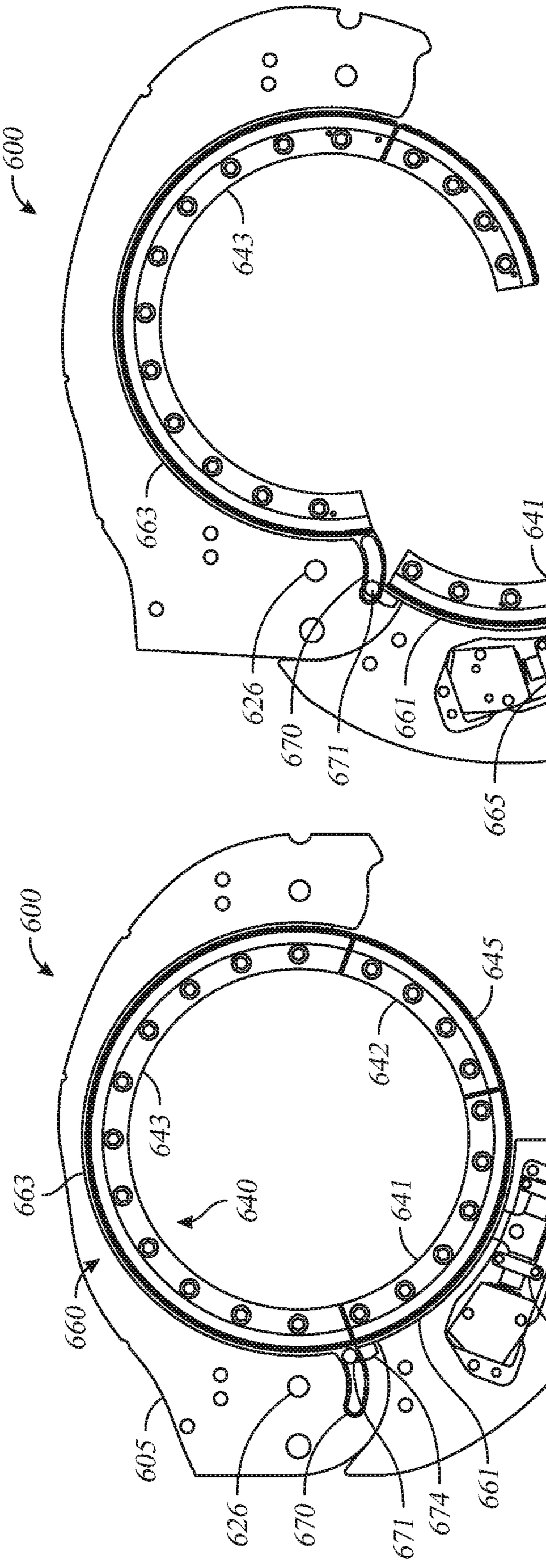
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Fig. 24

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Fig. 23

WELLBORE TONG

BACKGROUND

Field

Embodiments described herein generally relate to a tong for use at a wellbore. In particular, embodiments described herein relate to a braking assembly for a tong. In particular still, embodiments described herein relate to a brake band for a braking assembly for a tong.

Description of the Related Art

Wellbore tongs are well known in the art for making and breaking threaded connections between tubulars as strings are assembled or disassembled for use in a wellbore. Typically, a back-up or lower tong holds a tubular extending from the wellbore while an upper tong grasps and then rotates a new tubular into or out of the string. In most cases, the upper tong includes a mechanism to grasp the tubular and then, in a separate step, rotates the tubular to perform threading or unthreading. During the grasping step, one rotating portion of the assembly must be held in place while the gripping assembly operates. Thereafter, both portions are rotated as a unit during the threading operation. There is a need for an improved braking assembly for preventing or stopping a rotatable component of the tong.

SUMMARY

In one embodiment, a tong for use at a wellbore includes a tong body; at least one door pivotally coupled to the tong body and movable between an open position and a closed position; a carrier ring rotatable relative to the tong body; and a brake plate coupled to the carrier ring. The tong also includes a brake band configured to move with the at least one door between the open and closed positions, and a braking member for moving the brake band into contact with the brake plate to stop rotation of the carrier ring.

In another embodiment, a method of operating a tong includes opening a door of the tong, wherein the tong includes a tong body; the door pivotally coupled to the tong body; a carrier ring rotatable relative to the tong body; a brake plate coupled to the carrier ring; and a brake band having a door band portion attached to the door. The method also includes moving the door band portion of the brake band with the door as the door opens; closing the door; moving the brake band into contact with the carrier ring, thereby preventing rotation of the carrier ring; and rotating a gear ring relative to the carrier ring.

In another embodiment, a method of operating a tong includes opening a door of the tong. The tong may include a tong body; the door pivotally coupled to the tong body; a carrier ring rotatable relative to the tong body; a brake plate coupled to the carrier ring; and a brake band having a door band portion attached to the door. The method also includes moving the door band portion of the brake band with the door as the door opens; closing the door; rotating the carrier ring; and moving the brake band into contact with the brake plate, thereby stopping rotation of the carrier ring.

In one embodiment, a tong for use at a wellbore includes a tong body; at least one door pivotally coupled to the tong body and movable between an open position and a closed position; a gripping assembly rotatable relative to the tong body; and a brake plate coupled to the gripping assembly. The tong may also include a brake band configured to move with the at least one door between the open and closed positions; and a braking member for moving the brake band into contact with the brake plate to stop rotation of the gripping assembly.

BRIEF DESCRIPTION OF THE DRAWINGS

So that the manner in which the above recited features of the present disclosure can be understood in detail, a more particular description of the disclosure, briefly summarized above, may be had by reference to embodiments, some of which are illustrated in the appended drawings. It is to be noted, however, that the appended drawings illustrate only typical embodiments of this disclosure and are therefore not to be considered limiting of its scope, for the disclosure may admit to other equally effective embodiments.

FIG. **1** is a perspective view of a wellbore tong.

FIG. **2** is a perspective view of a portion of the tong including a rotatable brake plate, a gripping assembly rotatable therewith and a separately rotatable gear ring.

FIG. **3** is a top view of the assembly of FIG. **2** showing gripping members that are a part of the gripping assembly.

FIG. **4** is a perspective view of the gear ring showing a plurality of ramps formed on an inner surface thereof.

FIG. **5** is a perspective view of the gripping assembly illustrating a double pair of wheels on a first side and a single wheel on a second side.

FIG. **6** is a top view partially in section, taken through one wheel of the double pair of wheels.

FIG. **7** is a top view partially in section, taken through the single wheel.

FIG. **8** is a top view partially in section, taken through the single wheel and showing the gripping assembly actuated around a tubular.

FIG. **9** is a top view partially in section, taken through the single wheel and showing the tubular member having been rotated in a clockwise direction to make a wellbore connection between tubulars.

FIGS. **10** and **11** are top views of a braking member illustrating its operation in conjunction with a brake band to prevent rotation of the brake plate.

FIG. **12** is a perspective view of a brake plate illustrating the location of brake pads along an outer perimeter thereof.

FIG. **13** is a perspective view of another embodiment of a wellbore tong.

FIG. **14** shows a door of the tong of FIG. **13** in a closed position.

FIG. **15** shows the door of FIG. **14** in an open position.

FIG. **16** is a perspective bottom view of another embodiment of a wellbore tong.

FIG. **17** is a perspective view of the tong of FIG. **16** with one door in the open position.

FIG. **18** is a perspective view of an embodiment of a brake band.

FIG. **19** is a perspective view of the brake band of FIG. **18** with a first door band in the disengaged position and a second door band in a partially disengaged position.

FIG. **20** is a perspective view of the brake band of FIG. **18** with both door bands in the disengaged position.

FIG. **21** is a partial, perspective view of another embodiment of a wellbore tong.

FIG. **22** is a partial, perspective view of the tong of FIG. **21** with one door in the open position.

FIG. **23** is a partial, perspective view of another embodiment of a wellbore tong.

FIG. **24** is a partial, perspective view of the tong of FIG. **23** with one door in the open position.

DETAILED DESCRIPTION

FIG. **1** is a perspective view of a wellbore tong. The tong has two functions: it grasps a tubular (not shown) using a gripping assembly generally shown as **110** and thereafter, it rotates the tubular relative to a tubular therebelow in order to make or break a threaded connection therebetween. A door **120**, shown in a closed position, permits the tubular to be inserted into the gripping assembly **110** of the tong **100**. A hydraulic motor assembly generally shown as **130** rotates a gear ring (not visible) that is responsible for rotation of the tubular when a connection is made. Separately, a "cage" or brake plate **140** is rotatable independent of the gear ring. In the embodiment shown, the gripping assembly **110** is associated with the rotatable brake plate **140** and rotates therewith. Separately, inwardly facing ramps (not visible) are formed on an inner surface of the gear ring. To grip a tubular with the tong **100**, it is necessary to rotationally fix the brake plate **140** with its gripping assembly **110** while rotating the gear ring in order to urge the ramps of the gear ring under a plurality of wheels associated with the gripping assembly **110**. The action of the wheels and ramps acts to close gripping members **112**, **115** around the tubular. With the tubular gripped, both the gear ring and the brake plate **140** rotate together to make (or break) a connection.

FIG. **2** is a perspective view of a portion of the tong **100** including the rotatable brake plate **140**, the gripping assembly **110** rotatable therewith and a separately rotatable gear ring **150**. The gear ring includes teeth formed on a perimeter thereof for engagement with corresponding teeth associated with the motor assembly **130** (FIG. **1**). Also shown in FIG. **2** is a braking assembly for the brake plate in order to stop its rotation during the gripping portion of the operation. The breaking assembly, as will be described in additional detail herein, includes a brake band **160** that can be tightened thereby providing friction between the band **160** and the brake plate **140**. The tightening takes place at each end of the band with piston-actuated braking members **165***a*, **165***b*.

FIG. **3** is a top view of the assembly of FIG. **2** showing gripping members **112**, **115** that are a part of the gripping assembly **110**. As illustrated, the gripping members can be actuated towards or away from the centerline of a tubular.

FIG. **4** is a perspective view of the gear ring **150** showing a plurality of ramps **205***a*, **210***a*, **215***b* formed on an inner surface thereof opposite an opening or throat of the ring. The upper and lower ramps **205***a*, **210***a* are constructed and arranged to operate with a set of double wheels **305**, **310** (FIG. **5**) in order to actuate one gripping member **115** of the gripping assembly **110** when a threaded connection is being made. The center ramp **215***b*, as is evident by its direction is constructed and arranged to actuate a single wheel **315** associated with gripping member **112** when a connection between tubulars is being broken. An opposite group of ramps, two of which **215***a*, **205***b* are visible in FIG. **4** are responsible for a reverse arrangement wherein a second set of double ramps (upper ramp **205***b* is visible) operates with the double wheels **305**, **310** to break a connection and a second single ramp **215***a* operates with the single wheel **315** when a connection is made.

FIG. **5** is a perspective view of the gripping assembly **110** illustrating the double pair of wheels **305**, **310** on a first side and the single wheel **315** on a second side. The gripping assembly **110** is made up of two gripping members **112**, **115**, each operating like a slip with an inner surface having a concave shape to match the outer surface of the tubular to be grasped by the tong **100**. As illustrated, the gripping assembly **110** utilizes the single wheel **315** associated with one gripping member **112** and the two-wheel set **305**, **310** operating with a second gripping member **115**. In operation, the wheels (along with the brake plate **140**) remain rotationally fixed while the gear ring **150** with its various ramps rotates to a position wherein each wheel has ridden up a ramp. The result is a clamping action forcing the gripping members **112**, **115** into contact with the tubular to be grasped. The make or break nature of the operation determines which set of ramps is utilized by the wheels as the tubular is gripped.

FIG. **6** is a top view partially in section, taken through one wheel **305** of the double pair of wheels **305**, **310** and FIG. **7** is a top view partially in section, taken through the single wheel **315**. In both Figures, the gripping mechanism is de-activated, meaning that the wheels and ramps are not in contact with one another as indicated by the open position of the gripping members **112**, **155** in each Figure. For example, in FIG. **6**, upper wheel **305** of the pair of wheels **305**, **310** is visible above the ramp **215***a* that is designed to operate in conjunction with single wheel **315** when a connection is being made up. Similarly in FIG. **7**, on the left side of the Figure, the single wheel **315** is visible with the lower ramp **210***b* below it.

FIG. **8** is a top view partially in section, taken through the single wheel **315** and showing the gripping assembly **110** actuated around a tubular **400**. More specifically, FIG. **8** is a top section view of the assembly shown in FIGS. **7** and **8** with the view taken through the single wheel **315**. However, in FIG. **8** the gear ring **150** with its sets of ramps has been rotated clockwise while the brake plate **140** and gripping assembly **110** have been rotationally held in the same orientation as they are in FIGS. **7** and **8**. The result is that the ramps have changed location relative to the wheels **305**, **310**, **315** in a manner whereby the wheels have mounted the ramps **215***a*, **205***a*, **210***a* that are designed to be utilized in actuating the gripping mechanism in order to make a connection. Because the wheels have been actuated by the ramps, the gripping mechanism **110** is actuated and the tubular **400** is gripped.

FIG. **9** is a top view partially in section, taken through the single wheel **315** and showing the tubular member **400** having been rotated in a clockwise direction to make a wellbore connection between tubulars. Comparing FIGS. **8** and **9**, in FIG. **9** the entire tong unit including gear ring **150** and brake plate **140** has been rotated as a unit. In this manner the tubular **400** retained by the upper portion of the tong **100** is rotated relative to a tubular gripped by a lower portion (not shown) in order to make a threaded connection. It will be appreciated the operation can be reversed, using the same wheels but operating on another set of ramps having reverse formations. In this manner, the tong assembly can be used to make or break a threaded connection between tubulars.

As described above, in order to actuate the gripping assembly **110**, the brake plate **140** and gripping assembly must be rotationally fixed or at least rotationally limited relative to the gear ring while the gear ring **150** with its inwardly facing ramps rotates to a location whereby the ramps interact with the wheels of the gripping assembly to close the gripping members **112**, **115** around a tubular **400**. Thereafter, the gear wheel **150** and brake plate **140** rotate together to make or break a threaded connection. In one embodiment, rotation of the brake plate **140** is prevented with the use of a brake band **160** that is tightened around an outer surface of the plate in order to prevent its rotation. The

brake band **160** and braking members **165***a, b* are shown in FIGS. **2** and **3**. As shown, the band **160** extends around an outer perimeter of the plate **140** and is held at each end by one of the braking members. By holding the band at each end, the brake members can tighten the band **160** by urging each end towards the door **120** of the assembly, essentially removing slack in the band and thereby increasing its friction with the side of the brake plate **140**. In one embodiment, the braking members each include a piston that urges a corresponding end of the brake band **160** in order to tighten it.

FIGS. **10** and **11** are top views showing the operation of one of the braking members **165***b* and its relationship with the brake plate **140**. In FIG. **10** the brake is un-actuated as shown by a gap **146** formed between the band and an outer edge of a brake pad **145** disposed around an outer edge of the plate. FIG. **11** is a similar view however, in FIG. **11** the brake band has been tightened as apparent by the absence of gap **146** in the Figure. Arrow **149** illustrates the direction of a force placed upon the band in order to tighten it.

One novel aspect of the invention relates to brake pads and their location relative to the brake band and brake plate. In prior art devices, friction and heat generated between the tightened band and brake plate create wear and can cause failure of the entire tong assembly, essentially shutting down operations at a well site. In prior art devices, brake material including non-metallic, semi metallic and ceramic materials has been used on an inner surface of the brake band in order to effect braking between the band and brake plate. In order to extend the life of the brake band and to reduce friction and resulting heat between the surfaces, grease is applied at the intersection of the band and plate. The addition of grease reduces the heat and wear but must be replaced regularly requiring precious time at the working wellsite. Additionally, with or without grease, flexing of the band as it is tightened or loosened can cause the brake material to separate from the band. In one embodiment of the present invention, these problems and others are overcome by placing brake pads made of breaking and friction-reducing material not on the band but on the outer perimeter of the brake plate where it contacts the band.

FIG. **12** is a perspective view of the brake plate having apertures **142** around its perimeter for attachment of brake pads. One exemplary brake pad **145** is shown in the Figure. By fastening the brake pads with fasteners around the perimeter, a braking surface is provided in a manner whereby the material is protected from the flexing of the brake band. Additionally, the pieces can be replaced in any area where excessive wear has occurred without replacing the entire band or a large strip of the braking material. In one example, the brake pads are constructed primarily of bronze or sintered bronze. Bronze is an alloy consisting primarily of copper, commonly with about 12% tin and often with the addition of other metals and sometimes non-metals or metalloids such as arsenic, phosphorus or silicon.

FIG. **13** is a perspective view of another embodiment of a wellbore tong **300**. The tong **300** includes a body **505** and two doors **321**, **322** pivotally connected to the body **505**. The doors **321**, **322** are opened to allow ingress or egress of a tubular. The doors **321**, **322** can be opened using any suitable manner, such as a piston and cylinder assembly or manually. The tong **300** includes a gripping assembly having a carrier ring **350** housing one or more gripping members. It is contemplated that any suitable carrier ring and gripping members, such as those shown in FIGS. **1**, **2**, **16**, and **17** may be used.

In one embodiment, the carrier ring **350** is a segmented carrier ring having a body ring portion and two door ring portions. When the tong **300** is in the unactivated position, the body ring portion is coupled to the body **505**, and each door ring portion is coupled to a door **321**, **322**. The door ring portion is movable with the respective door **321**, **322**, when the door **321**, **322** opens or closes. A gear ring (e.g., gear ring **459** shown in FIG. **17**) is coupled to the carrier ring **350**.

The tong **300** includes a segmented brake plate **340** having a body plate **343** and two door plates **341**, **342**. The body plate **343** is attached to the body ring portion, and each door plate **341**, **342** is attached to a door ring portion. The brake plate **340** is rotatable with the carrier ring **350**. In this embodiment, the brake plate **340** is attached to an upper surface of the carrier ring **350**. In another embodiment, the brake plate **340** is attached to a lower surface of the carrier ring **350**. The door plates **341**, **342** are movable with the respective door **321**, **322**, when the door **321**, **322** opens or closes. In one embodiment, a brake pad **345** is attached to a perimeter wall surface of the brake plate **340**. An exemplary brake pad **345** is the brake pad **145** described in FIGS. **10-12**. As discussed, one or more of the brake pads **345** can be attached to apertures in the perimeter wall surface of the brake plate **340**. In another embodiment, the brake pads can be attached to the brake band **361**, **362**.

In one embodiment, the tong **300** includes one or more segmented brake bands **361**, **362**. As shown in FIG. **13**, two brake bands **361**, **362** are provided on the tong **300**. For sake of clarity, only one brake band **361** will be described. FIGS. **14** and **15** show the brake band **361** disposed on the tong **300**, which is shown with only one door **321**. FIG. **14** shows the door **321** in the closed position. The brake band **361** includes a first band portion **371** coupled to a second band portion **372** using a braking member **365**. In one example, the braking member **365** such as a cylinder assembly is used to couple the first and second band portions **371**, **372**. A piston extends out of one end of the cylinder assembly and is pivotally coupled to one end of each band portion **371**, **372**. The outer end of the first band portion **371** is pivotally coupled to the first door **321**, such as via a first pin connection **376**. The outer end of the second band portion **372** is pivotally coupled to the tong body **505**, such as via second pin connection **377**. In one embodiment, the distance between the first and second pin connections **376**, **377** is from 25% to 75% of the circumference of the brake plate **340** or from 35% to 60% of the circumference of the brake plate **340**. It is contemplated the braking member can be a dual piston and cylinder that pivotally couples the first band portion **371** and the second band portion **372**.

FIG. **15** shows the door **321** in the open position. As the door **321** swings out, the brake band **361** is allowed to pivot about both pin connections **376**, **377**. The band portions **371**, **372** also pivot about the connections with the pistons of the braking member **365**.

The brake band **361** is shown in FIG. **14** in the unactuated position. A gap exists between the brake band **361** and the brake plate **340**. To stop rotation of the brake plate **340**, the braking member **365** is actuated to tighten the brake band **361**. For example, one or both of the pistons of the braking member **365** are retracted to move at least a portion of the brake band **361** into contact with the brake plate **340**. As a result, friction between the brake band **361** and the brake plate **340** is increased, thereby stopping rotation of the brake plate **340** and the carrier ring **350**.

FIG. **16** is a perspective bottom view of another embodiment of a wellbore tong **400**. FIG. **17** is a perspective view

of the tong **400** with one door **422** in the open position. The tong **400** includes a body **405** and two doors **421**, **422** pivotally connected to the body **405**. The doors **421**, **422** are opened to allow ingress or egress of a tubular. The doors **421**, **422** can be opened using any suitable mechanism, such as a piston and cylinder assembly or manually. The tong **400** includes a gripping assembly having a carrier ring **450** housing one or more gripping members **408**.

In one embodiment, the carrier ring **450** is a segmented carrier ring having a body ring portion **453** and two door ring portions **451**, **452**. When the tong **400** is in the unactivated position, the body ring portion **453** is coupled to the body **405**, and each door ring portion **451**, **452** is coupled to a door **421**, **422**. The door ring portion **451**, **452** is movable with the respective door **421**, **422**, when the door **421**, **422** opens or closes. A gear ring **459** is coupled to the carrier ring **450** and is selectively rotatable relative to the carrier ring **450**. The gear ring **459** is segmented to accommodate movement of the door ring portions **451**, **452** with the doors **421**, **422**.

The tong **400** includes a segmented brake plate **440** having a body plate **443** and two door plates **441**, **442**. The body plate **443** is attached to the body ring portion **453**, and each door plate **441**, **442** is attached to a door ring portion **451**, **452**. The brake plate **440** is rotatable with the carrier ring **450**. In this embodiment, the brake plate **440** is attached to a lower surface of the carrier ring **450**. In another embodiment, the brake plate **440** is attached to an upper surface of the carrier ring **450**. The door plates **441**, **442** are movable with the respective door **421**, **422**, when the door **421**, **422** opens or closes. In one embodiment, a brake pad **445** is attached to a perimeter wall surface of the brake plate **440**. An exemplary brake pad **445** is the brake pad **145** described in FIGS. **10-12**. As discussed, one or more brake pads **445** can be attached to apertures in the perimeter wall surface of the brake plate **440**. In another embodiment, the brake pads can be attached to the brake band **460**.

In one embodiment, the tong **400** includes a brake band **460** having a plurality of segments **461**, **462**, **463**. FIG. **18** shows an exemplary embodiment of the brake band **460**. The brake band **460** is disposed around a perimeter of the brake plate **440** and configured to make contact with the brake plate **440**. The brake band **460** includes a body band **463** coupled to the body **405** of the tong **400**. The brake band **460** may be attached to the body **405** using a bracket **466**. One or more retainers **467** may be used to keep the brake band **460** in position around the brake plate **440**. The first and second door bands **461**, **462** are coupled to the doors **421**, **422**, respectively, and are movable with the doors **421**, **422** as the doors **421**, **422** open or close. In this embodiment, the door bands **461**, **462** are coupled to the doors **421**, **422** using a braking member **465** such as a piston and cylinder assembly. In one embodiment, the door bands **461**, **462** include a hinge **456** for pivotally coupling with the piston of the braking member **465**. For example, a pin can be inserted through a hole **457** in the hinge **456** and a hole in the piston. In this manner, the door bands **461**, **462** can be moved by the respective braking member **465**.

In one embodiment, the door bands **461**, **462** are connected to the body band **463** using a latch **470**, as shown in FIG. **18**. The latch **470** includes a catch **471**, **472** on the door bands **461**, **462** for receiving a dog **473**, **474** protruding from the body band **463**. In one example, the catch **471**, **472** has a hook shape. When the dog **473**, **474** is engaged in the catch **471**, **472**, a pull force from the braking member **465** is transferred to the body band **463** to tighten the brake band **460** around the brake plate **440**. The latch **470** is configured such that as the doors **421**, **422** open, the catch **471**, **472** disengages from the dogs **473**, **474**. FIG. **17** shows the catch **471** on the first door band **461** engaged with the dog **473** on the body band **463**, and the catch **472** on the second door band **462** fully disengaged from the dog **474** on the body band **463**. FIG. **19** shows the catch **471** on the first door band **461** fully disengaged from the dog **473** on the body band **463**, and the catch **472** on the second door band **462** partially disengaged from the dog **474** on the body band **463**. FIG. **20** shows the catch **471**, **472** on both door bands **461**, **462** fully disengaged from the dogs **473**, **474** of the body band **463** as a result of opening the doors **421**, **422**.

In operation, the doors **421**, **422** are opened to allow a tubular to enter the tong **400**. As the doors **421**, **422** open, the door bands **461**, **462** move with the doors **421**, **422** and disengage from the dogs **473**, **474** on the body band **463**. FIG. **20** shows the door bands **461**, **462** disengaged from the body band **463**. After the tubular enters the tong **400**, the doors **421**, **422** are closed. As the doors **421**, **422** rotate back, the catch **471**, **472** will engage the respective dog **473**, **474**. FIG. **19** shows the first door band **461** still disengaged from the body band **463**, and the second door band **462** partially engaged with the door band **463**. It can be seen the dog **474** is partially engaged with the catch **472** on the second door band **462**. When the doors **421**, **422** are closed, the door bands **461**, **462** are engaged with the body band **463**. FIG. **18** shows the catch **471**, **472** on both door bands **461**, **462** engaged with the dogs **473**, **474** of the body band **463** as a result of closing the doors **421**, **422**.

To grip a tubular, the braking member **465** is activated to tighten the brake band **460** around the brake plate **440**. The brake band **460** applies a frictional force against the brake plate **440** to prevent rotation of the carrier ring **450**. In this respect, the gear ring **459** is allowed to rotate relative to the carrier ring **450**. The gear ring **459** may act as a cam to urge the gripping members **408** into contact with the tubular.

FIG. **21** is a partial, perspective view of another embodiment of a wellbore tong **500**. FIG. **22** is a perspective view of the tong **500** with one door **522** in the open position. Because the tong **500** has many of the same features described in the tong **400** shown in FIG. **17**, the tong **500** will be described with respect to only one of the doors **522**. The door **522** pivots at the door hinge **526** relative to the tong body. The door **522** is opened to allow ingress or egress of a tubular. The door **522** can be opened using any suitable mechanism, such as a piston and cylinder assembly or manually. The tong **500** includes a gripping assembly having a carrier ring **550** housing one or more gripping members. It is contemplated that any suitable carrier ring and gripping members, such as those shown in FIGS. **16** and **17** may be used.

In one embodiment, the carrier ring **550** is a segmented carrier ring having a body ring portion and two door ring portions, e.g., carrier ring **450** of FIGS. **16**, **17**. Only one door **522** is shown in FIG. **22**. The door ring portion is movable with the door **522**, when the door **522** opens or closes. However, FIG. **22** shows the door ring portion in the closed position while the door **522** is open in order to more clearly show the features of the brake band **560**.

The tong **500** includes a segmented brake plate **540** having a body plate **543** and two door plates **541**, **542**. The body plate **543** is attached to the body ring portion, and each door plate **541**, **542** is attached to a door ring portion. The brake plate **540** is rotatable with the carrier ring **550**. In this embodiment, the brake plate **540** is attached to a lower surface of the carrier ring **550**. In another embodiment, the brake plate **540** is attached to an upper surface of the carrier ring **550**. The door plate **542** is movable with the respective

door **522**, when the door **522** opens or closes. In one embodiment, a brake pad is attached to a perimeter wall surface of the brake plate **540**. An exemplary brake pad is the brake pad **145** described in FIGS. **10-12**. As discussed, one or more brake pads can be attached to apertures in the perimeter wall surface of the brake plate **540**.

In one embodiment, the tong **500** includes one or more brake bands **560** for holding or stopping rotation of the carrier ring **550**. In FIG. **22**, the brake band **560** is coupled to the door **522**. While not shown, another brake band **560** is preferably coupled to the other door. The brake band **560** includes a first segment **561** pivotally coupled to a second segment **562**. In another embodiment, the brake band **560** is a single segment or includes three or more segments. A first end of the brake band is pivotally coupled to a braking member **565**, and a second end of the brake band is pivotally coupled to the tong body. In this embodiment, a band hinge plate **563** is attached to the tong body. The first segment **561** of the brake band **560** is pivotally attached to a pin **574** on the door hinge plate **563**. In this embodiment, a hinge cut out **528** is formed in the door hinge plate **527** to accommodate the pin **574** and the door band **560**. The second segment **562** is pivotally attached to a hinge **567** of the braking member **565**. The hinge **567** extends from the piston of the braking member **565** and is movable with the piston.

In operation, the doors of the tong **500** are opened to allow a tubular to enter the tong **500**. For sake of clarity, only the operation of one of the doors **522** will be described. As the door **522** opens, the brake band **560** moves with the door **522** and pivot about the pin **574** on the band hinge plate **575**. The brake band **560** also pivots relative to the braking member **565**. The piston of the braking member **565** also moves the hinge **567** as the door **522** opens. FIG. **22** shows the brake band **560** in the open position with the door **522**. After the tubular enters the tong **500**, the door **522** is closed. As the door **522** rotates back, the brake band **560** will rotate with the door **522** about the pivotal connections **574**, **567**. FIG. **20** shows the brake band **560** in the closed position. The hinge **567** has moved from the position shown in FIG. **22**. The braking member **565** is activated to tighten the brake band **560** around the brake plate **540**. The brake band **560** applies a frictional force against the brake plate **540** to prevent rotation of the carrier ring **550**. In this respect, a gear ring is allowed to rotate relative to the carrier ring **550**, thereby urging the gripping members into contact with the tubular.

FIG. **23** is a partial, perspective view of another embodiment of a wellbore tong **600**. FIG. **24** is a perspective view of the tong **600** with one door **621** in the open position. Because the tong **600** has many of the same features described in the tong **400** shown in FIG. **17**, the tong **600** will be described with respect to only one of the doors **621**. The other door is not shown for sake of clarity. The door **621** pivots at the door hinge **626** relative to the tong body **605**. The door **621** is opened to allow ingress or egress of a tubular. The door **621** can be opened using any suitable mechanism, such as a piston and cylinder assembly or manually. The tong **600** includes a gripping assembly having a carrier ring (such as carrier ring **450** of FIGS. **16**, **17**) and a gripping member, which are not shown for sake of clarity. It is contemplated that any suitable gripping assembly, such as those shown in FIGS. **1-2** and **16-17** may be used. In one embodiment, the carrier ring is a segmented carrier ring having a body ring portion and two door ring portions. The door ring portion is movable with the door **621**, when the door **621** opens or closes.

The tong **600** includes a segmented brake plate **640** having a body plate **643** and two door plates **641**, **642**. The body plate **643** is attached to the body ring portion, and each door plate **641**, **642** is attached to a door ring portion. The brake plate **640** is rotatable with the carrier ring. In one embodiment, the brake plate **640** is attached to a lower surface of the carrier ring. In another embodiment, the brake plate **640** is attached to an upper surface of the carrier ring. The door plate **641** is movable with the respective door **621**, when the door **621** opens or closes. In one embodiment, a brake pad **645** is attached to a perimeter wall surface of the brake plate **640**. An exemplary brake pad is the brake pad **145** described in FIGS. **10-12**. As discussed, one or more brake pads can be attached to apertures in the perimeter wall surface of the brake plate **640**.

In one embodiment, the tong **600** includes a brake band **660** having a plurality of segments. FIG. **23** shows an exemplary embodiment of the brake band **660**. The brake band **660** is disposed around a perimeter of the brake plate **640** and configured to make contact with the brake plate **640**. The brake band **660** includes a body band **663** coupled to the body **605** of the tong **600**. The brake band **660** may be attached to the body **605** using a bracket and one or more retainers may be used to keep the brake band **660** in position around the brake plate **640**. The brake band **660** also includes a first door band **661** and a second door band. For sake of clarity, this embodiment will be described with respect to the first door band **661** since the second door band operates in a similar manner. The first door band is coupled to the door **621** and is movable with the door **621** as the door **621** opens or closes. The first door band **661** is coupled to the door **621** using a braking member **665** such as a piston and cylinder assembly. In one embodiment, the first door band **661** includes a hinge for pivotally coupling with the piston of the braking member **665**. For example, a pin can be inserted through a hole in the hinge and a hole in the piston. In this manner, the first door band **661** can be moved by the respective braking member **665**.

In one embodiment, the door bands **661** are connected to the body band **663** using a guide slot **670**, as shown in FIG. **23**. In this embodiment, the guide slot **670** is attached to the body band **663**. A pin **671** on the first door band **661** is disposed in the guide slot **670**. The guide slot **670** is configured to accommodate movement of the pin **671** as the first door **621** opens or closes. In one example, the guide slot **670** has a curved shape. The pin **671** may be coupled to the first door band **661** using an adapter **674**. In FIG. **23**, the first door **621** is in a closed position. When a pull force from the braking member **665** is applied to the first door band **661**, the pull force is transferred from the first door band **661** to the body band **663** via the pin **671** and guide slot **670**. In this respect, the braking member **665** can apply the pull force to tighten the brake band **660** around the brake plate **640**. FIG. **24** shows the first door **621** in the open position. The pin **671** has moved outwardly with the first door **621** and along the guide slot **670**.

In operation, the doors of the tong **600** are opened to allow a tubular to enter the tong **600**. For sake of clarity, only the operation of one of the doors **621** will be described. As the door **621** opens, the first door band **661** moves with the door **621** and the pin **671** of the first door band **661** moves along the guide slot **670**. FIG. **24** shows the door **621** and the first door band **661** in the open position. After the tubular enters the tong **600**, the door **621** is closed. As the door **621** rotates back, the pin **671** of the first door band **661** moves back along the guide slot **670** toward the body band **663**. FIG. **23** shows the door **621** and the first door band **461** in the closed position. The braking members **665** are activated to tighten the brake band **660** around the brake plate **640**. Force from

the braking member **665** is applied to the first door band **661** and transferred to the body band **663** via the pin **671** and the guide slot **670**. The brake band **660** applies a frictional force against the brake plate **640** to prevent rotation of the carrier ring **550**. In this respect, the gear ring is allowed to rotate relative to the carrier ring **550**, thereby urging the gripping members into contact with the tubular.

In one embodiment, a method of operating a tong includes opening a door of the tong. The tong may include a tong body; the door pivotally coupled to the tong body; a carrier ring rotatable relative to the tong body; a brake plate coupled to the carrier ring; and a brake band having a door band portion attached to the door. The method also includes moving the door band portion of the brake band with the door as the door opens; closing the door; rotating the carrier ring; and moving the brake band into contact with the brake plate, thereby stopping rotation of the carrier ring.

In one embodiment, a tong for use at a wellbore includes a tong body; at least one door pivotally coupled to the tong body and movable between an open position and a closed position; a carrier ring rotatable relative to the tong body; a brake plate coupled to the carrier ring; a brake band configured to move with the at least one door between the open and closed positions; and a braking member for moving the brake band into contact with the brake plate to stop rotation of the carrier ring.

In one embodiment, a tong for use at a wellbore includes a tong body; at least one door pivotally coupled to the tong body and movable between an open position and a closed position; a gripping assembly rotatable relative to the tong body; and a brake plate coupled to the gripping assembly. The tong may also include a brake band configured to move with the at least one door between the open and closed positions; and a braking member for moving the brake band into contact with the brake plate to stop rotation of the gripping assembly.

In one or more of the embodiments described herein, the brake band includes a body band attached to the tong body; and a door band attached to and movable with the door, wherein the door band is engaged with the body band when the door is in the closed position, and the door band is disengaged from the body band when the door is in the open position.

In one or more of the embodiments described herein, the door band includes a catch configured to receive a dog of the body band when the door is in the closed position.

In one or more of the embodiments described herein, the braking member is attached to the door.

In one or more of the embodiments described herein, the brake plate includes a body plate attached to the tong body and a door plate attached to and movable with the door.

In one or more of the embodiments described herein, the tong includes a first door and a second door, and the brake band includes a body band attached to the tong body; a first door band attached to and movable with the first door; and a second door band attached to and movable with the second door, wherein the first and second door bands are engaged with the body band when the doors are in the closed position, and the first and second door bands are disengaged from the body band when the doors are in the open position.

In one or more of the embodiments described herein, the first end of the brake band is pivotally attached to the door, and a second end of the brake band is pivotally attached to the tong body.

In one or more of the embodiments described herein, the second end of the brake band is pivotally attached to a pin on the tong body.

In one or more of the embodiments described herein, the braking member is attached to the door, and wherein the first end of the brake band is pivotally coupled to the braking member.

In one or more of the embodiments described herein, the brake band includes a first brake band portion pivotally coupled to a second brake band portion.

In one or more of the embodiments described herein, the door includes a hinge cut out to accommodate the pin.

In one or more of the embodiments described herein, the brake band includes a first brake band portion pivotally coupled to a second brake band portion.

In one or more of the embodiments described herein, the braking member pivotally couples the first brake band portion to the second brake band portion.

In one or more of the embodiments described herein, the braking member includes a first piston coupled to the first brake band portion and a second piston coupled to the second brake band portion.

In one or more of the embodiments described herein, the tong includes a first door and a second door, wherein the first end of the brake band is pivotally attached to the first door and the second end of the brake band is pivotally attached to the tong body. The tong may further include a second brake band having a first end pivotally attached to the second door and a second end pivotally attached to the tong body.

In one or more of the embodiments described herein, the brake band includes a body band attached to the tong body and having a guide slot; and a door band attached to and movable with the door, wherein the door band is coupled to the guide slot.

In one or more of the embodiments described herein, the door band includes a pin disposed in the guide slot.

In another embodiment, a method of operating a tong includes opening a door of the tong, wherein the tong includes a tong body; the door pivotally coupled to the tong body; a carrier ring rotatable relative to the tong body; a brake plate coupled to the carrier ring; and a brake band having a door band portion attached to the door. The method also includes moving the door band portion of the brake band with the door as the door opens; closing the door; moving the brake band into contact with the carrier ring, thereby preventing rotation of the carrier ring; and rotating a gear ring relative to the carrier ring.

In one or more of the embodiments described herein, moving the door band portion includes disengaging the door band portion from a body band portion of the brake band attached to the tong body.

In one or more of the embodiments described herein, closing the door includes engaging the door band portion with the body band portion.

In one or more of the embodiments described herein, moving the brake band into contact includes transferring a force from the door band portion to the body band portion.

In one or more of the embodiments described herein, moving the door band portion includes moving a pin of the door band portion along a guide slot of a body band portion of the brake band.

In one or more of the embodiments described herein, moving the brake band into contact with the brake plate includes actuating a braking member to apply a force to the brake band to move the brake band relative to the brake plate.

While the foregoing is directed to embodiments of the present disclosure, other and further embodiments of the

disclosure may be devised without departing from the basic scope thereof, and the scope thereof is determined by the claims that follow.

The invention claimed is:

1. A tong for use at a wellbore, comprising:
a tong body;
at least one door pivotally coupled to the tong body and movable between an open position and a closed position;
a carrier ring rotatable relative to the tong body;
a brake plate coupled to the carrier ring;
a brake band configured to move with the at least one door between the open and closed positions; and
a braking member for moving the brake band into contact with the brake plate to stop rotation of the carrier ring.

2. The tong of claim **1**, wherein the brake band includes:
a body band attached to the tong body; and
a door band attached to and movable with the door, wherein the door band is engaged with the body band when the door is in the closed position, and the door band is disengaged from the body band when the door is in the open position.

3. The tong of claim **2**, wherein the door band includes a catch configured to receive a dog of the body band when the door is in the closed position.

4. The tong of claim **3**, wherein the braking member is attached to the door.

5. The tong of claim **2**, wherein the brake plate includes a body plate attached to the tong body and a door plate attached to and movable with the door.

6. The tong of claim **2**, wherein the tong includes a first door and a second door, and the brake band includes:
a body band attached to the tong body;
a first door band attached to and movable with the first door; and
a second door band attached to and movable with the second door, wherein the first and second door bands are engaged with the body band when the doors are in the closed position, and the first and second door bands are disengaged from the body band when the doors are in the open position.

7. The tong of claim **1**, wherein the first end of the brake band is pivotally attached to the door, and a second end of the brake band is pivotally attached to the tong body.

8. The tong of claim **7**, wherein the second end of the brake band is pivotally attached to a pin on the tong body.

9. The tong of claim **8**, wherein the braking member is attached to the door, and wherein the first end of the brake band is pivotally coupled to the braking member.

10. The tong of claim **9**, wherein the brake band includes a first brake band portion pivotally coupled to a second brake band portion.

11. The tong of claim **8**, wherein the door includes a hinge cut out to accommodate the pin.

12. The tong of claim **7**, wherein the brake band includes a first brake band portion pivotally coupled to a second brake band portion.

13. The tong of claim **12**, wherein the braking member pivotally couples the first brake band portion to the second brake band portion.

14. The tong of claim **7**, wherein the tong includes a first door and a second door, wherein the first end of the brake band is pivotally attached to the first door and the second end of the brake band is pivotally attached to the tong body, and further comprising:
a second brake band having a first end pivotally attached to the second door and a second end pivotally attached to the tong body.

15. The tong of claim **1**, wherein the brake band includes:
a body band attached to the tong body and having a guide slot; and
a door band attached to and movable with the door, wherein the door band is coupled to the guide slot.

16. The tong of claim **15**, wherein the door band includes a pin disposed in the guide slot.

17. A tong for use at a wellbore, comprising:
a tong body;
at least one door pivotally coupled to the tong body and movable between an open position and a closed position;
a gripping assembly rotatable relative to the tong body;
a brake plate coupled to the gripping assembly;
a brake band configured to move with the at least one door between the open and closed positions; and
a braking member for moving the brake band into contact with the brake plate to stop rotation of the gripping assembly.

18. A method of operating a tong, comprising:
opening a door of the tong, wherein the tong includes:
a tong body;
the door pivotally coupled to the tong body;
a carrier ring rotatable relative to the tong body;
a brake plate coupled to the carrier ring; and
a brake band having a door band portion attached to the door;
moving the door band portion of the brake band with the door as the door opens;
closing the door;
moving the brake band into contact with the carrier ring, thereby preventing rotation of the carrier ring; and
rotating a gear ring relative to the carrier ring.

19. The method of claim **18**, wherein moving the door band portion comprises disengaging the door band portion from a body band portion of the brake band attached to the tong body.

20. The method of claim **18**, wherein moving the door band portion comprises moving a pin of the door band portion along a guide slot of a body band portion of the brake band.

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